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TRASANA

TECHNICAL REPORT NO. 3-78

FLIGHT PROFILE PERFORMANCE HANDBOOK

VOLUME VIIA - CH-47A (CHINOOK)



APRIL 1979

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DEPARTMENT OF THE ARMY
US ARMY TRADOC SYSTEMS ANALYSIS ACTIVITY
WHITE SANDS MISSILE RANGE
NEW MEXICO 88002

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FLIGHT PROFILE PERFORMANCE HANDBOOK.

VOLUME VIIA F CH-47A (CHINOOK)

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DEPARTMENT OF THE ARMY
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ACKNOWLEDGMENT

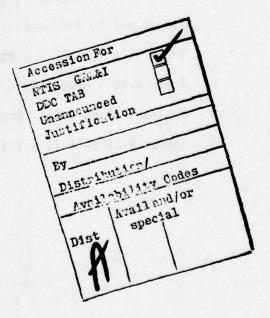
At AVRADCOM, Mr. Harold Sell, Mr. James O'Malley and Mr. Dale Pitt provided and validated the data in the Handbook. They also assisted in devising the formats to assure clarity in the data presentation and discussion.

At TRASANA, Mr. Frank Gonzalez provided help and guidance during the preparation of the Handbook.

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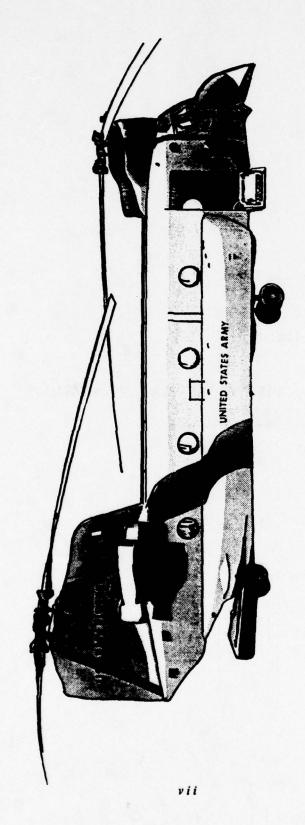
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CH-47 CHINOOK

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CHAPTER 1

INTRODUCTION

1. PURPOSE

The purpose for preparing this handbook series is fourfold: (a) to validate CHINOOK performance data quickly, (b) to reduce the manpower and time to prepare accurate flight profiles, (c) to standardize performance data so that the analysis community can benefit from a single reference in conducting studies and (d) to provide a handbook that can be used for training in the mission profile planning area.

2. BACKGROUND

The CHINOOK performance data contained in this Flight Profile Performance Handbook (FPPH) series was originally acquired as a data base for the Aircraft Mission Processing Simulation (AMPS) model. AMPS is a computer program developed by the Aviation Systems Analysis Branch of the US Army TRADOC Systems Analysis Activity (TRASANA) to support Cost and Operational Effectiveness Analyses (COEAs). AMPS generates detailed flight profiles for a wide variety of helicopter missions. The data was provided TRASANA by the Army Aviation Research and Development Command (AVRADCOM) and was the most accurate data available to AVRADCOM at the time of handbook publication. In structuring the data base for AMPS it was noted that the data, when properly organized, could provide a method of doing quick and simple flight profile simulations. This volume presents the CHINOOK data and explains how it can be used.

3. OBJECTIVES OF THE HANDBOOK

- a. <u>Data Validation</u>. This volume of the handbook contains tables with the precise performance data and format required to develop flight profiles for computer simulations. Using the handbooks as a reference, the individual project manager (PM) will be able to quickly validate or update as required all associated data contained in the different tables. If this procedure is followed by the various PMs, support of Helicopter COEAs and other analyses can be efficiently implemented.
- b. Flight Profile Development. Much of the manpower and time spent in preparing flight profiles for supporting aircraft COEAs is dedicated to look-up, correlation and validation of performance data. Once the procedure contained in this handbook is implemented, flight profiles can be easily prepared. What normally took one man 4 to 5 days to prepare can now be prepared in 3 to 4 hours.

- c. Standardization of Performance Data. Each of the PMs has been contacted by AVRADCOM to validate the performance data contained in each handbook in this series. Once each handbook is published, the data contained will be kept current as of the publication date. Since the requests for current information are constantly being forwarded to the PMs by analysis groups, this handbook can be a reference and assure a commonality in studies within the community.
- d. Training for Planning Missions and Flight Profiles. For training purposes each handbook can stand alone. It is only a matter of following the example provided and applying the proper data to fit the flight profile desired. Although the example shown is simplistic, the methodology may be expanded to apply to any flight profile no matter how complex.

4. OTHER VOLUMES

This handbook is one of a series that covers the helicopters in the US Army inventory. The complete set of handbooks and their subjects are:

Volume I - FPPH Description

Volume II - UH-60A (BLACKHAWK)

Volume III - AH-1G (COBRA)

Volume IV - AH-1S (COBRA)

Volume V - YAH-64 (Advanced Attack Helicopter [AAH])

Volume VI - OH-58C (KIOWA)

Volume VII - CH-47 (CHINOOK)

Volume VIII - CH-54 (TARHE)

Volume IX - UH-1H (HUEY)

5. GENERAL HANDBOOK DESCRIPTION

a. Performance Data. The data contained in these volumes is CHINOOK performance data compiled from the results of actual experiments. It is not engineering data and is not intended to serve as a base for future helicopter construction or acquisition. The more mature the helicopter becomes, the less likely there will be a change in the basic performance data.

- b. Handbook Organization. This volume is one of a series of volumes as identified in paragraph 4 above. Volume I is a description of the methodology used to develop the tables for each of the other volumes. This volume and all other volumes except Volume I provides a simplified flight profile example in Chapter 2. Chapter 3 provides an explanation of each of the five types of data tables contained in the handbook. The five types of tables deal with: (1) Basic Fuel Flow Data, (2) Delta Fuel Flow for Drag Data, (3) Ground Idle Fuel Flow Data, (4) Gross Weight Limits Data and, (5) Velocity Limits data. Chapter 4 contains the actual tables to be used for developing flight profiles.
- c. Volume VII Organization. The US Army has four different versions of the CH-47 CHINOOK. Due to the large amount of data for these four versions and to allow for easier reference, there is a separate section of Volume VII for each. Volume VIIA contains data for the CH-47A. In the same manner, Volume VIIB contains CH-47B data, Volume VIIC contains CH-47C data, and Volume VIID contains CH-47D data.

CHAPTER 2

FLIGHT PROFILE EXAMPLE

1. GENERAL

This chapter provides an example of how to develop a flight profile, albeit simple, that can be extended to cover any number of stops, loads and distances all depending on helicopter capability and fuel available.

2. DISCUSSION

a. The main question this example of a flight profile will answer is, "Do I have enough fuel to fly the proposed mission?"

b. Suppose a pilot is to fly a simple resupply mission in a CH-47A CHINOOK helicopter that calls for flying (as shown in illustration 2-1) from point A (the air base), to point B (the pick up area) to point C (the drop off area) and return to A.

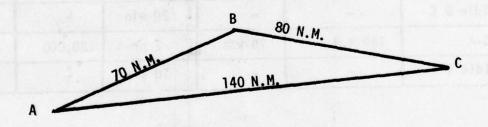


Illustration 2-1

c. The other information given is airspeed (AS) from A to B which is to be 70 knots (kts), from B to C 40 kts, and from C to A 70 kts. The CHINOOK helicopter is to be flown, at 4,000 ft for all legs at an ambient temperature of 15°C, and an idle altitude for take off, pick-up and drop off areas (ground level) of 2000 ft*. The mission plan also shows 10 minutes idle at A before take off, 20 minutes idle at B while loading, 20 minutes idle at C while unloading and 10 minutes idle on return to A before shut down. The CHINOOK will be flown empty at a gross weight (GW) of 20,000 lbs from A to B and from C to A, while the cargo from B to C will be 12,000 lbs.

^{*}All altitudes are in reference to sea level.

d. The flight plan is prepared by drawing up a table similar to Table 2-1 below. By filling in the blanks under fuel, it can be determined if the total is too large for the helicopter.

TABLE 2-1

Helicopter: CHINOOK (CH-47A)

Altitude: 4000 ft flight/2000 ft idle

Temperature: 15°C

LEG	DISTANCE	AS	TIME	GW (1bs)	FUEL
Idle @ A	Part NuM	•	10 min	ione worf (
A-B	70 N.M.	70 kts	1 hr	20,000	ili Marka a nja
Idle @ B	•		20 min	10 - 10 -	
B-C	80 N.M.	40 kts	2 hr	32,000	
Idle @ C		•	20 min	•	
C-A	140 N.M.	70 kts	2 hr	20,000	
Idle @ A	-	-	10 min	-	

e. First fill in Idle @ A, Idle @ B, Idle @ C and 2nd Idle @ A since they will all come from Table 2-2. In each case the idle is at 2000 ft and a temperature of 15°C. Consulting the ground idle fuel shown in Table 2-2, the value of 1124 lbs/hr is at the intersection of 2000 ft and 15°C.

1st Idle $@A = 1/6 \times 1124 = 187$ lbs

Idle @ B = 1/3 X 1124 = 375 lbs

Idle $0 C = 1/3 \times 1124 = 375 \text{ lbs}$

2nd Idle @ A = 1/6 X 1124 = 187 lbs

GROUND IDLE FUEL FLOW
AIRCRAFT - CH-47A
CHINOOK

		PRESSI	PRESSURE ALTITUDE (FT)	JDE (FT)			
		SEA LEVEL	2000	4000	9009	8000	10000
	-25 C	1220	1164	1072	1000	932	869
IEMPERATURE	−5 C	1200	1.144	1052	980	912	048
DEGREES	15 C	1180	1124	1032	696	892	820
CENTICKADE	35 C	0911	1104	7101	046	872	906

ENTRIES ARE AIRCRAFT FUEL FIOR RATES IN LBS/HR

TAB LE 2-3

BASIC FUEL FLUW KATES FOR THE GIVEN CONDITIONS IN LESZHR
PRESSURE: 48018 FT TEMPERATURE: 15 7

AIRCRAFT - CH-47A

C	
,	×
	0
1	0
	Z
-	-
	I
	U
•	
,	
_	

GROSS	3.0			FL16	HT MOD	FLIGHT MODE (KTS)				
(185)	HIGE	HIGE HOGE	NOF	40	09	8.5		100 0120	140	160
20,000	h6h1	1663	1547	1432	1333	1316	1333 1316 1410 1586 1827	1586	1827	5194
24,000	1678	1678 1922	1521	1580	1465	1442	1465 1447 1518 1684	1684	1956	2447
28,000	1947	1947 2219	2008	1797	1634	1634 1589		1652 1827 2150	2150	2771
32,300	2244	2244 2599	2325	2551	1	1850 1777	1880		2148 2571	3320
33,000	2325	2697	2410	2325 2697 2410 2123 1912 1843 1980 2279 2743	1912	1843	1980	2279	2743	3563

Notice the conversion from minutes to hours. These values must be used because fuel flow is in lbs/hr.

- f. The fuel flow for the three legs of the mission are calculated next. The heading on Table 2-1 shows a need for the Basic Fuel Flow data chart for the CHINOOK helicopter flying at 4000 ft and at 15°C ambient temperature. Table 2-3 contains the necessary information.
- (1) Leg A-B is at 70 kts and 20,000 lbs. This is not one of the values given but 60 kts is 1333 lb/hr and 80 kts is 1316 lb/hr. Interpolation gives the value of 1325 lb/hr for a 70 kts airspeed. Since the leg is one hour long:

Leg A-B = $1 \times 1325 = 1325 \text{ lbs}$

(2) Leg B-C is at 40 kts and 32,000 lbs. This value is in the table; 2051 lbs/hr. Since the leg is two hours long:

Leg B-C = $2 \times 2051 = 4102 \text{ lbs}$

(3) Leg C-A is at 70 kts and 20,000 lbs. This fuel flow rate was computed above to be 1325 lbs/hr. Since the leg is two hours long:

Leg C-A = $2 \times 1325 = 2650 \text{ lbs.}$

g. The flight profile can be finished by filling in Table 2-1 as shown in Table 2-4.

TABLE 2-4

Helicopter: CHINOOK (CH-47A)

Altitude: 4000 ft flight/2000 ft Idle

Temperature: 15°C

LEG	DISTANCE	AS	TIME	GW (1bs)	FUEL
Idle @ A	•		10 min	-	187 lbs
А-В	70 N.M.	70 kts	1 hr	20,000	1325 lbs
Idle @ B	-	<u>-</u>	20 min	-	375 lbs
В-С	80 N.M.	40 kts	2 hr	32,000	4102 1bs
Idle 0 C	•	-	20 min	-	375 lbs
C-A	140 N.M.	70 kts	2 hr	20,000	2650 lbs
Idle @ A	-	-	10 min	-	187 1bs
				Total	9201 1bs

- h. Although only two look-up tables were used for this example, each type of table has several conditions that are changed so that a wide band of performance parameters can be addressed. The discussion on each of the five types of tables is contained in Chapter 3. A succinct description of each of these five types of tables is:
- (1) Basic Fuel Flow Data: Gives the rate the aircraft uses fuel dependent on the given flight conditions.
- (2) Delta Fuel Flow for Drag Data: Gives the additional rate of fuel flow to be added to the basic rate for external drag.
- (3) Ground Idle Fuel Flow Data: Gives the rate fuel is used when the aircraft is on the ground with its engine running.
- (4) Gross Weight Limits Data: A check on whether or not the aircraft has enough lift to take off with a given weight.
- (5) Velocity Limits Data: Gives the optimum (long range) speed and maximum rates of speed.

CHAPTER 3

PERFORMANCE DATA TABLE DESCRIPTIONS

1. GENERAL

This chapter describes each of the five basic type tables used for developing flight profiles. The variables within each type of table are described as well as how the specific data required can be extracted.

2. BASIC FUEL FLOW DATA

- a. The basic rate of fuel flow* is determined by five variables:
- (1) Type of aircraft
- (2) Altitude (Air Pressure)**
- (3) Temperature***
- (4) Gross Weight***
- (5) Flight Mode
- b. In each table (see Table 3-1) within the basic type, the first three variables are held constant for the whole table, i.e., (a) Type of Aircraft, (b) Altitude (Air Pressure) above sea level, and (c) Temperature. These variables are stated at the top of each table.
- c. There are five rows of fixed gross weights: 20,000 lbs, 24,000 lbs, 28,000 lbs, 32,000 lbs, and 33,000 lbs. The ten columns are fixed flight modes.
- (1) The first column is Hover In Ground Effect (HIGE). HIGE is used for hovers at a height of 10 feet or less and a component of forward flight 10 kts or less.
- (2) The second column is Hover Out of Ground Effect (HOGE). This is used for hovers at a height of more than 10 feet.

^{*}The basic fuel flow data represents a clean drag configuration with all doors closed, no wing stores, and no external sling loads.

^{**}All altitudes or air pressures are feet above sea level.

^{***}For simplicity, all temperatures are considered to be the average temperature in which the helicopter is operating (Degrees Centigrade).

****Total vehicle weight in pounds.

- (3) The third column is Nap of the Earth (NOE). This is defined as all flight for variable speeds from 0 to 40 kts and variable altitudes.
- (4) The remaining seven columns are for given airspeeds* (in kts) as the flight mode.
- d. There are 24 of these basic fuel flow charts. Each chart is for a different combination of Air Pressure (Altitude) and temperature.
- e. The Basic Fuel Flow Data is the main table used in simulating a flight profile. For example, assume a pilot's flight path will require 30 minutes of flight at 80 kts airspeed, 4000 ft. altitude, 15°C and a gross weight of 28000 lbs in a CH-47A helicopter. Using Table 3-1 at a gross weight of 28000 lbs and an airspeed of 80 kts, the helicopter will use 1589 lbs/hr fuel, i.e., for 30 minutes, 795 lbs of fuel will be used.
- f. The gross weight values selected provide the basic range of load carrying capability for the ten flight modes of the CHINOOK helicopter. Within the gross weight band shown, linear interpolation** is quite accurate for estimating the fuel flow rates.
- g. For example, using Table 3-1, if the helicopter's gross weight was 30,000 lbs and if the flight mode was 60 kts, the fuel flow cannot be found directly. But by interpolating between 60 kts, 28,000 lbs 1634 lbs/hr and 32,000 lbs 1850 lbs/hr, the basic fuel flow rate for 30,000 lbs is 1742 lbs/hr. In this example, if the helicopter flies in this mode for 30 minutes, 871 lbs of fuel will be used.
- h. As altitude and/or temperature changes occur, different tables are used to look up the aircraft's basic fuel flow rate for each leg of the flight path. Care must be taken that the proper table is used.
- i. Appendix A contains a set of functions that will give a good approximation of the basic rate of fuel flow.

3. DELTA FUEL FLOW FOR DRAG DATA

- a. The delta fuel flow for drag is also determined by five variables:
- (1) Type of Aircraft
- (2) Altitude (Air Pressure)
- (3) Temperature
- (4) Drag Surface (Equivalent Square Footage)
- (5) Air Speed

^{**}All references to airepeeds are to true airepeeds.

**All references to interpolation are linear interpolations. See FPPH,

Volume I, Chapter 3 for a discussion on the accuracy of interpolation.

TABLE 3-1

FUEL FLOW RATES FOR THE GIVEN CONDITIONS IN LESTHA PRESSURE: 4000 FT TEMPERATURE: 15 c BASIC FUEL FLOW

TEMPERATURE: 15 C

AIRCHAFT - CH-47A

CHINOOK

GROSS				FLIG	FLIGHT MODE (KTS)	Ł (KTS	_			
(188)	HIGE	HOGE	NOF	40	09	8.0	100	120	140	160
20,000	1494	1663	4451	1432	1333	1316	1410	1586	1827	5194
24,000	1678	1922	1521	1580	1465	1442	1518	1684	1956	2447
28,000	1947	2219	2008	1441	1634	1589	1652	1827	2150	1772
32,000	2244	6652	2322	2051	1850	1777	1880	2148	1252	3320
33,000	2325	2325 2697 2410 2123	2410	2123	1912 1843 1980 2279	1843	1980	2279	2743	3583

TABLE 3-2

CORRECTION FUEL FLOW LBS/HR FOR EXTERNAL DRAG PRESSURE: 40c0 FT TEMPERATURE: 15 C AIRCRAFT - CH-47A

CHINOOK

			1 A	K SPEF	AIR SPEED IN KTS	TS		
		40	6.0	80	101	120 1	140	160
0	. ne	14	9 11	109	218	380	603	168
2 2 2	100	28	93	221	438	761	1198	1783
7 20 30 - 110 0	150	42	139	333	454	1135	1135 1797	2676
SWUANE FEET	200	5.6	56 186	944		878 1512 2375	2375	3569

- b. Like the basic fuel flow tables, there are 24 tables for delta fuel flow for drag.
- c. There are four fixed rows of equivalent square feet of drag: 50 equivalent sq ft thru 200 equivalent sq ft.
- d. The seven columns are for airspeeds in kts of: 40 kts, 60 kts, 80 kts, 100 kts, 120 kts, 140 kts, and 160 kts.
- e. When an external load is placed on the helicopter, the amount of fuel consumed per hour increases. The delta fuel flow for drag tables indicate how much extra fuel consumption to add to the basic fuel flow rate.
- f. In the example given earlier, a 30 minute flight at 80 kts airspeed, 4000 ft altitude, 15°C and a gross weight of 28,000 lbs was used. Using the basic fuel flow tables, the basic fuel flow rate was 1589 lbs/hr. Assuming for this new example that part of the load is external and inducing a 100 equivalent sq ft external drag, the delta fuel flow for drag (Table 3-2) shows 221 lbs/hr should be added to the basic fuel flow rate. Thus the basic fuel flow rate becomes 1589 t 221 or 1810 lbs per hour and for a half-hour flight, 905 lbs of fuel will be used instead of the 795 lbs figured without an external load.
- g. Appendix B contains a function that will give a good approximation of the delta fuel flow for drag.

4. GROUND IDLE FUEL FLOW DATA

- a. The ground idle fuel flow rate is determined by only three variables:
 - (1) Type of Aircraft
 - (2) Altitude (Air Pressure)
 - (3) Temperature
- b. There is only one ground idle fuel flow table (shown as Table 2-2). The table has four rows of temperatures: -25°C , -5°C , 15°C and 35°C , and six columns of altitudes: Sea Level, 2000 ft, 4000 ft., 6000 ft., 8000 ft., and 10000 ft.
- c. The ground idle fuel flow table is used as discussed in the example flight profile in Chapter 2 (Table 2-2). The CH-47A helicopter idling for 20 minutes at 2000 ft. altitude and 15°C, (across the row labeled 15°C and down the column labeled 2000) find the intersection at 562. Thus, the CH-47A uses 1124 lbs/hr at these conditions and since it is idling for 20 minutes or 1/3 of an hour, it will use 375 lbs of fuel.

- d. If the helicopter had only been 1000 ft. above sea level, the consumption rate would be found by interpolating between the sea level rate of 1180 lbs/hr and the 2000 ft. rate of 1124 lbs/hr which would be 1152 lbs/hr. In 1/3 of an hour 384 lbs of fuel would be used.
- e. Appendix C contains a function that will give a good approximation of the ground idle fuel flow.

5. GROSS WEIGHT LIMITS DATA

- a. Gross weight limits tables are intended to show whether or not the aircraft can safely take off for four sets of criteria. These criteria are defined in the following paragraphs:
- (1) Criteria #1 is based on the helicopter using 100% of Maximum Power for take off and having enough power to lift straight up and above ground effect (See Figure 3-1). Once it is in hovering above ground effect level the helicopter begins forward flight until it acquires, transitional lift and is able to climb at 450 ft/min (a desired standard rate of climb) to the desired altitude. This criteria has some risk since the pilot has no reserve power. It has less risk than Criteria #3 but more than Criteria #2 thus it is considered to be "Middle of the Road" risk.
- (2) Criteria #2 (Figure 3-1) is based on the helicopter using 95% of Maximum Power for take off and enough power to immediately begin to climb at a rate of 450 ft/min. This is the least risky criteria since the pilot has power in reserve and is still able to climb at a satisfactory rate.
- (3) Criteria #3 (Figure 3-1) has the most risk. Using 100% of Maximum Power the helicopter will only hover in ground effect. Therefore, at an altitude of 10 feet or less, the pilot must begin forward flight and gradually increase airspeed to acquire transitional lift to climb. The reasons for its high risk are readily apparent. First, there is no power in reserve. Second, the pilot must begin forward flight at a very low altitude.
- (4) Criteria #4. Structural Gross Weight Limits is the total upper limit of gross weight the helicopter can carry under any take off criteria.
 - b. Gross Weight Limits are determined by four variables:
 - (1) Type of Aircraft
 - (2) Criteria Chosen
 - (3) Altitude (Air Pressure)
 - (4) Temperature

CRITERIA #1

(MIDDLE OF THE ROAD)

100% MAX POWER, HOGE

TRANSITIONAL LIFT

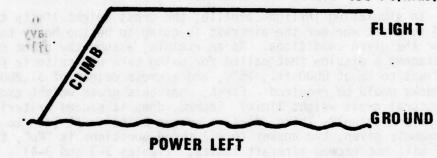
CLIMB

GROUND

NOTHING TO SPARE.

CRITERIA #2 (LEAST RISKY)

95% OF RATED POWER. VERTICAL RATE OF CLIMB 450 FT/MIN, HOGE



CRITERIA #3
(MOST RISKY)

100% MAX POWER, HIGE

TRANSITIONAL LIFT CLIMB
HIGE GROUND
NOTHING TO SPARE.

Figure 3-1

- c. Additionally, Criteria #1, #2, and #3 differ due to engine power limits or transmission power limits of the aircraft. Thus there are six tables:
 - (1) Criteria #1 (Due to engine)
 - (2) Criteria #1 (Due to transmission)
 - (3) Criteria #2 (Due to engine)
 - (4) Criteria #2 (Due to transmission)
 - (5) Criteria #3 (Due to engine)
 - (6) Criteria #3 (Due to transmission)
- d. The structural gross weight limit is a single value for each helicopter and is only dependent on the type helicopter. The CH-47A structural gross weight limit is given as 33,000 lbs and is listed at the bottom of each table. As the name implies, it is simply not safe to expect the CH-47A structure to maneuver normally when the total weight is larger than that value.
- e. In simulating inflight profile, the gross weight limits tables are used to check whether the aircraft is going to be too heavy to take off under the given conditions. As an example, assume the pilot of a CH-47A planned a mission that called for using take off criteria #1 and the take off was to be at 8000 ft., 15°C, and a gross weight of 31,200. Three checks would be required: First, does this gross weight exceed the structural gross weight limit? Second, does it exceed Criteria #1 (due to transmission)? Third, does it exceed Criteria #1 (due to engine)? In the example given, the answer to all three questions is "No", the take off will not exceed aircraft limits. (Tables 3-3 and 3-4)
- f. If the assigned gross weight had been 32,000 lbs, it would have exceeded the value given for 8,000 ft. and 15°C at Criteria #1 (Due to engine). (Table 3-3) The mission could not be flown as planned. The plan could be changed, for example to take off at 6000 ft. (which might not be practical) or change to take off Criteria #3 (which is more risky but has higher limits).
- g. If the assigned gross weight had been 33,200 lbs., it would have exceeded the structural limits. To perform the mission the only choices would be to lighten the load or get another type helicopter.
- h. Appendix D contains a set of functions that will give a good approximation of the gross weight limits for takeoff.

TABLE 3-3

GROSS WEIGHT LIMITS
(DUE TO ENGINE)
FOR TAKEOFF CRITERIA HI
1008 OF MAXIMUM POWER (HOGF)
AIRCRAFT - CH-47A

CHINDOK

		PRES	PRESSURE ALTITUNE (FT)	TUDE (FT)			
		SEA LEVEL	0002	100h	0009	9000	16639
TEMPORATION	-25 C	22264	11596	43785	41036	38116	35354
OFGREES	75 €	36134	43339	43417	37459	34732	32036
CENTIGRADE	15 C	42167	39346	36504	33859	31277	28865
) SE	37216	34754	32301	29903	27651	25545

ENTRIES ARE AIRCRAFT GROSS WEIGHTS IN LBS

STRUCTURAL GROSS BEIGHT LIMIT: 33000 LBS

TABLE 3-4

GROSS WEIGHT LIMITS

(DUE TO TRANSHISSION)

1008 OF MAXIMUM POWER (HOGE) FOR TAKEDLE CRITERIA #1

AIRCRAFT - CH-47A

CHINDOK

		PRES	PRESSURE ALTITUDE (FT)	TUDE (FT)			
		SEA LEVEL	2000	Gouh	6000	ប្រាប្បទ	16002
	-25 C	40975	29765	18986	37576	36481	35354
TEMPERATURE	-5 C	39712	38599	37533	36466	35352	34207
DEGREES	15 C	38612	19546	36504	35413	34285	33138
- FRIERADE	35 C	37642	10998	35527	34418	33286	32154

ENTRIES ARE AIRCRAFT GROSS WEIGHTS IN LBS

STRUCTURAL GRUSS REIGHT LIMIT: 33000 LBS

6. VELOCITY LIMITS DATA

- a. There are various types of data given in these tables but like the gross weight limits tables, they are primarily restraints on what can be expected of a helicopter in planning a mission profile. Velocity limits tables are influenced by five variables:
 - (1) Type of aircraft
 - (2) Air pressure (altitude)
 - (3) Temperature
 - (4) Gross weight
 - (5) Condition or limit
- b. Items (1) through (4) are self-explanatory. There are five types of information that can be listed under (5):
 - (1) Long range
 - (2) Maximum continuous power
 - (3) Maximum power (due to engine limits)
 - (4) Transmission limits
 - (5) V_{ne}(velocity never exceed)
- c. For each aircraft, there are 24 Velocity Limits Tables depending on air pressure and temperature combination. Table 3-5 is an example of the content of the Velocity Limits Table.
- d. The two columns under Long Range (Table 3-5) give the optimum speed and fuel flow for each set of variables #1 through #4 above. Thus the CH-47A operating at 2000 ft., temperature 15°C, and having a gross weight of 28,000 lbs will fly a longer distance if the velocity is kept at 137 kts and will use 2148 lbs/hr of fuel at that velocity.
- e. Maximum continuous power gives the fastest speed at which a helicopter can fly for long periods (30 minutes or more) and the associated fuel flow rate. An example from Table 3-5 would be a CH-47A at 2000 ft. and 15° weighing 28,000 lbs could fly 164 kts with a fuel usage of 2954 lbs/hr.

TABLE 3-5

VELOCITY LIMITS TABLE

(INCLUDING FUEL FLOW RATES)

PRESSURE: 2000 FT TEMPERATURE: 15 C

AIRCRAFT - CH-47A

CHINOOK

those tables but like.

	78	RANGE	CONTINUOUS	NUOUS REPOS	7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7	Z E Z	TRANS	TRANSHISSION LIMITS	VELOC	VELOCITY NEVER EXCEED
	VEL (KTS)	(LBS/HR)	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	(LBS/HR)		VEL F.F.	VEL (KTS)	F.F. (L85/HR)
GROSS FEIGHTS (LBS)	idaT a	ned scowling adi as	e Mass	(0690) ire afte	eng tm	ale Srij Ona bi			er io e ioni e io eli e eret	
20,000	147	2035	193	2954	215	3396	201	3111	122	1691
24,000	1 42	2088	178	7954	195	3396	184	3111	122	1787
28,000	137	8412	164	1962	177	3396	169	3111	122	1899
32,000	136	2962	155	1967	166	3396	159	3111	107	1915
33,000	135	2452	152	h567	163	3396	156	3111	103	1934

- f. Maximum power (engine and transmission limits) show the maximum speeds the aircraft can structurally attain for short periods of time (less than 30 minutes). Thus the CH-47A helicopter at 2000 ft and 15°C weighing 28,000 lbs has an engine that is capable of producing enough power to fly 177 kts but the transmission limits the aircraft to 169 kts. Between these two columns then, the flight cannot exceed 169 kts with a fuel flow rate of 3111 lbs/hr.
- g. There is another limiting factor called V_{ne} (velocity never exceed). This velocity limit is determined by helicopter structural considerations. V_{ne} 's are used in the same manner as maximum power limits described in paragraph f above. Since a value of 122 kts is listed for 2,000 ft., 15°C, and 28,000 lbs, this implies that none of the values in d, e, or f can be reached.

7. DETAILED FLIGHT PROFILE USING ALL PERFORMANCE DATA TABLES

The example of a Flight Profile in Chapter 2 was intentionally simplified to assure clarity. The description of the various tables in this handbook, however, indicates a more complex set of considerations are normally encountered in developing the flight profile. With the description provided in this chapter, additional information should be included in the flight plan beyond that shown in the example and a suggested format is provided below in Table 3-6.

TABLE 3-6

Helicopter: Altitude: Temperature:

LEG	DISTANCE	AS	CHECK VELOCITY LIMIT	TIME	CM (LBS)	DRAG	FUEL
	•						

Needed for each take off:
Weight at take off:
Type of take off:
Check transmission limits:
Check engine limits:
Check structural gross weight limit:

CHAPTER 4

CHINOOK (CH-47A) PERFORMANCE DATA TABLES

GENERAL

The following tables are the major information presented in this hand-book. If the procedure for using them is understood, a flight profile for the CHINOOK (CH-47A) helicopter can be prepared in a matter of a few hours. The performance data contained have been reviewed for accuracy and are corrected to the best of our knowledge. The tables are organized in the following manner:

Tables 4-1 to 4-24

Basic Fuel Flow Data

Tables 4-25 to 4-48

Delta Fuel Flow for Drag Data

Table 4-49

Ground Idle Fuel Flow Data

Tables 4-50 to 4-55

Gross Weight Limits Data

Tables 4-56 to 4-79

Velocity Limits Data

BASIC FUEL FLOW DATA
TABLES

24

TABLE 4-1

BASIC FUEL FLOW
FUEL FLOW RATES FAR THE GIVEN CUNDITIONS IN LBS/MM
PRESSURE: SEALEVEL TEMPERATURE: -25 C

AIRCRAFT - CH-47A CHINOOK

20.00				3.1.3	SON SI	2.4.7	-			
2002	Comment of the Commen			5174	20H 1H	PEIGHT MODE (NIS)				
(605)	391H	HIGE HOGE	NOF	08 69 69 80	09	80	001	100 120 140	140	160
20 • 300	1524	1660	1613	1524 1660 1613 1566 1434 1424 1581 1852 2210 2686	1434	1424	1881	1852	2210	2686
24,000	1696	1888	1777	1696 1888 1777 1667 1536 1525 1681 1957 2318 2879	1536	1525	1891	1957	2318	2879
28,000	1885	2131	1956	1885 2131 1956 1781 1653 1642 1788 2064 2446	1653	1642	1788	2064	2446	3107
32,000	4602	2389	2164	2094 2389 2164 1939	1792	1776	1910	1792 1776 1910 2177 2597	1652	3420
33,000	2150	2458	2223	2150 2458 2223 1988 1830 1813 1943 2207 2640	1830	1813	1943	2207	2640	3158

TABLE 4-2

BASIC FUEL FLOW FUEL FLOW RATES FOR THE GIVEN CONDITIONS IN LBS/HR

PRESSURE: SEA LEVEL TEMPERATURE: "5 C

AIRCRAFT - CH-47A CHINOOK

						7.7				
GROSS				FLIG	HT MOD	FLIGHT MODE (KTS)				
WEIGHIS (LBS)	HIGE	HIGE HOGE	NOE		09	40 60 80 100 120 149 160	1 00	120	140	160
20,000	1555	1555 1701 1635 1569 1442 1426 1562 1793 2102	1635	6951	1442	1426	1562	1793	2012	5152
24,000	1733	1733 1933 1802 1671 1550 1532 1659 1892 2209 2675	1802	1671	1550	1532	6591	1892	2209	2675
28,000	1930	1930 2185 1993 1801 1675 1654 1765 1996 2334 2902	1993	1801	1675	1654	1765	9661	2334	2062
32,000	2156	2156 2456 2224 1992 1825 1793 1891 2112 2494 3213	4222	1992	1825	1793	1881	2112	5657	3213
33,000	2218	2218 2531 2290 2048 1868 1831 1926 2148 2545 33UU	2290	2548	1868	1831	1926	2148	2545	3300

TABLE 4-3

BASIC FUEL FLOW RATES FOR THE GIVEN CONDITIONS IN LBS/HR PRESSURE: SEA LEVEL TEMPERATURE: 15 C

AIRCRAFT - CH-47A

CHINOOK

GROSS				FLIG	FLIGHT MODE (KTS)	E (KTS				
WEIGHIS (LOS)	HIGE	HIGE HOGE NOE 40 60 80 100 120 140	NOE	40	09	80	100	120	140	160
20.000	1587	1587 1740 1657 1574 1456 1438 1557 1762 2032	1657	1574	9561	1438	1551	1762	2032	2410
24.000	1770	1770 1978 1831 1683 1570 1549 1654 1857 2140 2584	1831	1683	1570	1549	1654	1857	2140	2584
28,000	1978	1978 2239 2039 1839 1705 1677 1765 1956 2273 2850	2039	1839	1705	1677	1765	1956	2273	2850
32,000	2226	2533	2295	2056	1872	1824	1897	2095	2463	2226 2533 2295 2056 1872 1824 1897 2095 2463 3174
33,000	2295	2295 2619 2368 2116 1920 1864 1934 2145 2528 3257	2368	2116	1920	1864	1934	2145	2528	3257

TABLE 4-4

FUEL FLOW RATES FOR THE GIVEN CONDITIONS IN LBS/HR PRESSURE: SEA LEVEL TEMPERATURE: 35 C BASIC FUEL FLOW

CHINDOK

GROSS				FLIG	HT MOD	FLIGHT MODE (KTS)	1			P 8-2
5)5	H 1 GE	HIGE HOGE	NOE	40	09		80 100 120 140 160	120	140	160
20 • 300	1618	1618 1779	1680	1582	1473	1680 1582 1473 1454 1559	1559	1746 1988	1988	2346
24,300	1809	1809 2023 1863 1704 1594 1571 1659 1838	1863	1704	1594	1571	1659	1838	2100 2	2542
28,000	2030	2030 2296 2092 1888 1742 1706 1776 1942 2247	2602	1888	1742	1706	1776	1942	2247	2839
32,000	2303	2303 2627 2374 2122 1929 1863 1920 2129	4182	2122	1929	1863	1920	2129	2493	3170
33,000	2378	2378 2724 2455 2185 1982 1908 1971 2205 2599 3288	2455	2185	1982	1908	1971	2205	2599	3288

TABLE 4-5

BASIC FUEL FLOW
FUEL FLOW RATES FOR THE GIVEN CONDITIONS IN LUS/HR
PRESSURE: 2000 FT TEMPERATURE: -25 C
AIRCRAFT - CH-47A

CHINDOK

GROSS				FLIG	HT MOD	FLIGHT MODE (KTS)	•			
(1881)	HIGE	HIGE HOGE	NOE		40 60	80	80 100 120 140	120	140	160
20,000	1476	1621	1557	1492	8981	1476 1621 1557 1492 1368 1358 1504 1758	1504	1758	1602	2575
24.000	1654	1857	1726	1595	1476	1654 1857 1726 1595 1476 1466 1606 1865 2207	9091	1865	2207	2764
28,000	1853	2106	1916	1726	1602	1853 2106 1916 1726 1602 1591 1720 1974 2345 3032	1720	1974	2345	3035
32,000	2076	2379	2148	1161	9541	2076 2379 2148 1917 1756 1736 1853 2095 2546 3393	1853	5602	2546	3393
33,300	2137	4542	2213	1973	1800	2137 2454 2213 1973 1800 1775 1890 2133 2602 3492	0681	2133	2602	3492

TABLE 4-6

BASIC FUEL FLOW
FUEL FLOW RATES FOR THE GIVEN CONDITIONS IN LAS/HR
PRESSURE: 2000 FT TEMPERATURE: -5 C

CHINDOK

					A. 12. 24. 0	- 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1				
GR055				FL16	HT NOD	FLIGHT MODE (KTS)	•			
(1881)	HIGE	HOGE	NOE	40	09	80	100	120	120 140	160
20.000	1507	1991	1577	6661	1377	1377 1361	9841	1021	1990	2389
24.000	1691	1962	1752	1603	1651	h2h:	:474 1585	1802	2104	2574
28,000	1902	1912	1961	1762	1627	1961 1762 1627 1604 1701	1041	1909	2242	2842
32,000	2148	2459	2220	2220 1981		1798 1755 1840	1840	2054	2444	3213
33,000	2217	2217 2545	2293	2040	1848	2293 2043 1848 1797 1878 2105 2513	1878	2105	2513	3302

TABLE 4-7

FUEL FLOW RATES FOR THE GIVEN CONDITIONS IN LAS/HR TEMPERATURE: 15 C HASIC FUEL FLOW PRESSURE: 2000 FT

AIRCRAFT - CH-47A CHINOOK

GROSS				FLIG	HT MOC	·LIGHT MODE (KTS)	5.1			
(Les)	39 I H	HOGE	NOE	40	09	80	100	120	140	160
20.000	1538	6691	6651	6641	1392	1374	1481	1671	1925	2294
24,000	1730	1461	1785	1623	1513	1492	1582	1767	2043	2503
28,000	1955	2220	5002	1181	1662	1629	1703	1878	2196	2807
32,300	2228	2558	2303	2048	1854	1789	1854	2017	2456	3149
33,000	2303	2656	2384	2111	1989	1836	6061	2157	2562	3278

TABLE 4-8

FUEL FLOW RATES FOR THE GIVEN CONDITIONS IN LAS/HR BASIC FUEL FLOW

PRESSURE: 2000 FT TEMPERATURE: 35 C AIRCRAFT - CH-47A CHINOOK

GROSS				FLIG	HT MOD	FLIGHT MODE (KTS)	1			
"(LAS)	HIGE	HOGE	NOE	40	09	80	100	120	140	160
20,000	1570	1570 1737	1623	1509	1469	1391	1483	1655	1885	2240
24,300	1770	1770 1992	1823	1823 1854	1540	1516	1589	6421	2008	2478
28,000	2016	2016 2287	2077	2077 1867	1705	1660	1890 1718	1882	2193	2802
32,000	2312	2666	2393	2119	9161	1840	1929	2185	2586	3307
33,300	2390	2767	2479	2191	1677	1902	2026	1112	2758	1958

TABLE 4-9

EUEL FLOW KATES FOR THE GIVEN CONTITIONS IN LOS/HAPESSURE: 4000 FT TEMPERATURE: -25 CAIRCRAFT - CH-47A

		-	-	-	The second second	***** ********************************				
GROSS				FLIG	HT MOD	FLIGHT MODE (KTS)	-			
WE LOT IS	HIGE	HIGE HOGE	NOE	9.0	09	80	80 100 120 140	120	140	160
20,000	1432	1432 1588	1504	1421	1307	1504 1421 1307 1297 1433 1670	1433	1670	1981	2452
24,000	1619	1619 1829	1681	1532	1422	1681 1532 1422 1412 1539 1777	1539	1777	2106	2671
28,000	1829	1829 2088	1890	1692	1561	1890 1692 1561 1547 1661 1890 2258	1991	1890	2258	2987
32,000	2074	2074 2384		1910	1735	2147 1910 1735 1764 1867	1867	2041	2503	3380
33,000	2144	2466	2218	1969	1785	2144 2466 2218 1969 1785 1747 1846	1846	5094	2094 2577	3480

TABLE 4-10

FUEL FLOW RATES FOR THE GIVEN CONDITIONS IN LESSHR TEHPERATURE: -5 C AIRCRAFT - CH-47A CHINOOK BASIC FUEL FLOW PRESSURE: 4000 FT

GROSS				FLIG	FLIGHT MODE	E (KTS	. 1			
(LBS)	HIGE	HOGE	JON	40	09	08		100 120	0 h 1	091
20,000	1463	1626	5251	1424	1318	1303	1414	9191	1887	2277
24,000	1657	1657 1875	1712	8 + 5 1	1440	1423	1423 1519	6121	2009	2494
28,000	1884	2148	1944	1441	1592	1562	9491	9681	2112	2806
32,000	2157	2157 2487	2532	1477	1788	1729 1804	1804	1402	2445	3199
33,000	2234	2234 2581	2311	2040	1843	1981 2740 1843 1777 1861	1861	2123	2550	3339

TABLE 4-11

BASIC FUEL FLOW
FUEL FLOW RATES FOR THE GIVEN CONDITIONS IN LBS/HR
PRESSURE: 4000 FT TEMPERATURE: 15 c

AIRCRAFT - CH-47A
CHINOOK

GROSS				FLIG	HT MOD	FLIGHT MODE (KTS)	_			
(182)	HIGE	HIGE HOGE	NOF	40	09	40 60 89 100 120 140 160	100	120	140	160
20,000	1494	1663	1547	1494 1663 1547 1432 1333 1316 1410 1586 1827 2194	1333	131.6	1410	1586	1827	2194
24,000	1678	1922	1521	1678 1922 1751 1580 1465 1442 1518 1684 1956	1465	1442	1518	1684	1956	2447
28,000	1947	2219	2008	1947 2219 2008 1797 1634 1589 1652 1827 2150 2771	1634	1589	1652	1827	2150	2771
32,000	2244	5652	2325	2244 2599 2325 2051 1850 1777 1880 2148 2571	1850	1777	1880	2148	2571	3320
33,000	2325	2697	2410	2325 2697 2410 2123 1912 1843 1980 2279 2743 3583	1912	1843	1980	2279	2743	3583

TABLE 4-12

EASIC FUEL FLOW RATES FOR THE GIVEN CONDITIONS IN LBS/HR PRESSURE: 4000 FT TEMPERATURE: 35 C

GROSS				FLIG	HT MOD	FLIGHT MODE (KTS)	,			
(LBS)	HIGE	HIGE HOGE	NOE	40	09	40 60 80 100 120 140 160	100	120	140	160
20:000	1526	1700	1573	1526 1700 1573 1446 1353 1334 1413 1570 1791 2153	1353	1334	1413	1570	1621	2153
24:000	1742	1970	1795	1742 1970 1795 1621 1497 1467 1528 1671 1932 2437	1497	1467	1528	1671	1932	2437
28,000	2016	2304	2019	2016 2304 2079 1855 1685 1625 1675 1864 2186 2775	1685	1625	1675	1864	2186	2775
32,000	2330	2704	2423	2330 2704 2423 2142 1937 1879 2031 2330 2813 3657	1937	1879	1602	2330	2813	3657
33,000	2417	2805	2519	2417 2805 2519 2232 2032 1990 2147 2470 3013 3901	2032	3661	2147	2470	3013	3401

TABLE 4-13

BASIC FUEL FLOW
FUEL FLOW RATES FOR THE GIVEN CONDITIONS IN LBS/MR
PRESSURE: 6060 FT TEMPERAIJRE: -25 C

GROSS				FLIG	FLIGHT MODE	E (KTS)	(:)	6- 6-		
(Les)	HIGE	HOGE	NOE	40	90	8.3	001	120	140	091
20,000	1394	1559	1457	1356	1252	1243	1366	1588	1880	2345
24,000	1590	1806	1644	1482	1376	1366	1478	1691	2016	2603
28,000	1815	2082	1878	1675	1532	1512	1612	1821	2217	2966
32.009	2090	2413	2182	1912	1730	1683	1774	2035	2516	3379
33,000	2165	2510	2243	1977	1785	1731	1731 1830	2120	2630	3526

TABLE 4-14

BASIC FUEL FLOW
FUEL FLOK RATES FOR THE GIVEN CONDITIONS IN LRS/HR
PRESSURE: 6000 FT TEMPERATURE: -5 C

AIRCRAFT - CH-47A CHINOOK

GROSS				FLIG	HT MOD	FLIGHT MODE (KTS)	-			81.1
(188)	HIGE	HOGE	NOE	40	09	08	1 00	120	140	160
20.000	1425	9551	1478	1361	1264	1253	1348	1536	1792	1812
24,000	1631	1631 1854		1683 1512	1397	1378	1462	1 +91	1927	6642
28,000	1880	5512	1944	1732	1570	1530	1602	1641	2134	9082
32,000	1812	2532	5259	1981	1789	1724	1839	7712	1952	3397
33,000	1922	2632	2347	1902	2061 1852	1461 1641	1941	2260	2747	3669

TABLE 4-15

HASIC FUEL FLOW
FUEL FLOW RAIES FOR THE GIVEN CONDITIONS IN LAS/HR
PRESSURE: 6000 FT TENPERATURE: 15 C

GROSS				FLIG	SHT MO	FLIGHT MODE (KTS)	-			
(183)	HIGE	HIGE HOGE	NOF	40	09		80 100	120	140	160
20.000	9561	1634	1504	1374	1282	1456 1634 1504 1374 1282 1264 1345	1345	1506	1738	2114
24,000	1677	1904	1729	1554	1427	1904 1729 1554 1427 1399 1463 1614	1463	1614	1886	2408
28,000	1952	2246	5016	1792	1621	1952 2246 2019 1792 1621 1561 1619 1822 2159	1619	1822	2159	2763
32,000	2272	2272 2642	2363	2003	1882	1833	1833 1992 2308	2308	2813	3677
33,000	2357	2747	2463	2179	1961	1948	2112	2446	3015	2357 2747 2463 2179 1981 1948 2112 2446 3015 3036

TABLE 4-16

FUEL FLOW KATES FOR THE GIVEN CONDITIONS IN LBS/HR Pressure: 6000 ft temperature: 35 c

AIRCRAFT - CH-47A CHINOOK

					-						
GROSS				FLIG	HT MOD	FLIGHT MODE (KTS)	•			0.01	
(LBS)	HIGE	HOGE	BON	40	09	80	100	120	140	160	
20.000	1489	1291	1533	1396	1303	1283	1350	0611	1707	2086	
24.000	1728	0961	1821	1991	1464	1426	1476	1615	1882	2404	
28,000	2025	2340	8602	1856	1676	1191	1702	1935	2299	2954	
32,000	2368	2512	2487	2223	2043	2025	2172	2503	3092	9414	
33,000	2463	2463 2865	1192	7352 1192	2175	2175 2167	2326	2687	3346	4813	

TABLE 4-17

BASIC FUEL FLOW FUEL FLOW KATES FOR THE GIVEN CONDITIONS IN LBS/HR PRESSUKE: 8000 FT TEMPERATURE: -25 C

GROSS				FLIG	HT MOD	FLIGHT MODE (KTS)	-			8000
(L85)	H16E	HOGE	NOE	40	09	80	1 00	120	140	160
20,000	1361	1534	1416	1297	1203	1195	1305	1512	1789	2256
24,000	1568	1796	1621	1451	1339	1328	1426	1623	1938	1952
28,000	4181	2089	1880	1671	1516	1486	1573	1780	2187	2955
32,000	2114	2466	8612	1929	1736	1682	1812	1212	2655	3587
33,000	2612	5566	2285	2003	1800	1800 1749 1917	1917	2254	2844	3971

TABLE 4-18

BASIC FUEL FLOW FUEL FLOW RATES FOR THE GIVEN CONDITIONS IN LBS/HR Pressure: Buow Ft temperature: -5 c

CHINDOK

GROSS				FLIG	HT MOD	FLIGHT MODE (KTS)	1			
(587)	HIGE	HOGE	NOE	40	69	8.0	100	120	140	160
20,000	1392	1572	1440	1308	1217	1203	1289	1961	1706	2104
24,000	1615	1841	1667	1492	1365	1341	1413	1576	1863	2406
28,000	1892	2184	1957	1731	1564	1509	1577	1793	2151	2813
32,000	2269	2583	2306	2029	1831	1789	1963	2288	2824	3770
33,000	4622	2687	2406	2125		1935 1910	2085	2432	3030	4046

TABLE 4-19

FUEL FLOW KATES FOR THE GIVEN CONDITIONS IN LBS/HX PRESSURE: 8000 FT TEMPERATURE: 15 C

AIRCRAFT - CH-47A CHINOOK

GROSS				FLIG	FLIGHT MODE (KTS)	E (KTS	-			
(188)	HIGE	HOGE	NOE	40	09	80	001	120	041	091
20,000	1425	0191	1470 1	1330	1237	1219	1287	1432	6591	9562
24,000	6991	1961	1721	1541	1961	1364	1417	1567	1844	2377
28,000	6961	2822	2040	1798	1620	1558	1664	6061	1622	2980
32,000	2311	9692	2440	2181	2006	1995	1512	2492	3109	4924
33.000	2467	2813	2565	2317	2144 2142 2305 2691 3385	2142	2305	1692	3385	6005

TABLE 4-20

BASIC FUEL FLOW RATES FOR THE GIVEN CONDITIONS IN LBS/HR Pressure: 600c ft temperature: 35 c

IRCRAFT _ CH-47

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GROSS				FLIG	FLIGHT MODE (KTS)	E (KTS	1			
(182)	HIGE	HOGE	NOE	04	09	80	100	120	140	091
20.000	0941	8691	1504	1981	1921	1239	1294	1418	1635	2243
24,000	1728	1261	1782	0651	1445	1393	1437	1598	1873	2378
28,000	2045	4782	2129	1884	1710	1667	1802	2071	2514	3259
32,000	6142	1882	2616	2409	2235	2234	2404	2840	3653	5795
33,000	2152	0562	2776	2992	2410	2411 2612	2612	3164	4266	1569

TABLE 4-21

HASIC FUEL FLOW KATES FOR THE GIVEN CONDITIONS IN LAS/MR PRESSURE: 1000C FT TEMPERATURE: -25 C

AIRCRAFT - CH-47A CHINDOK

GROSS				FLIG	HT MOD	FLIGHT MODE (KTS)	_			
WEIGHTS (1.85)	HIGE	HIGE HOGE	NOE	40	09	8.0	100	120	140	160
20,000	1334	1512	1381	1250	1911	1334 1512 1381 1250 1161 1153	1251	1440 1708 2189	1748	2189
24,000	1556	1784	1610	1436	1313	1556 1784 1610 1436 1313 1276 1382	1382	1961 1951	1961	2452
28,000	1834	1834 2123 1899	6681	1675	1514	8122 124 1470 1550 1790 2218	1550	1790	2218	4762
32.000	2148	2522	2247	1972	1786	2148 2522 2247 1972 1786 1756 1942 2292 2934	1942	2222	2934	3983
33,000	2234	2627	2347	2068	1889	2234 2627 2347 2068 1889 1877 2063 2438 3152 4272	2063	2438	3152	4272

TABLE 4-22

RASIC FUEL FLOW
FUEL FLOW KATES FOR THE GIVEN CONDITIONS IN LBS/HH
PRESSURE: 10000 FT TEMPERATURE: -5 C

GK055				FLIG	HT MOD	FLIGHT MODE (KTS)	1			
(LAS)	HIGE	HIGE HOGE	NOE	40	09	08		100 120 140	140	091
20,000	1367	1551	1410	1270	1177	1367 1551 1410 1270 1177 1162 1236	1236	1392	1631	2432
24.000	1191	1611 1847		1485	1346	1666 1485 1346 1312 1373 1535	1373	1535	1830	2405
28,000	1915	2227	1986	1745	1568	1915 2227 1986 1745 1568 1514 1632 1896 2299	1632	1896	2299	3061
32,000	2257	2646 2389	2389	2133	1968	1968 1966 2128	2128	1642	3158	6444
33,000	2354	1922	2518	2276	2104	2761 2518 2276 2104 2,10 2291 2700 3454 5232	1622	2700	3454	5232

TABLE 4-23

BASIC FUEL FLOW FUEL FLOW KATES FOR THE GIVEN CUNDITIONS IN LBS/HR PRESSURE: 10000 FT TEMPERATURE: 15 C

CHINOOK

AIRCRAFT - CH-47A

GROSS				FLIG	HT NOD	FLIGHT NODE (KTS)	1			
(507)	HIGE	HIGE HOGE	NOE	04	09	90		100 120 140	140	160
20,000	1403	1403 1591	1446	1302	1200	1302 1200 1179 1236	1236	2651 9961	1592	2018
24,000	1673	1924	1730	1536	1390	1924 1730 1536 1390 1339 1388	1388	1951 1951	1850	2368
28,000	5661	2324	2081	1838	1667	1995 2324 2081 1838 1667 1633 1773 2055	1773	2055	2522	3289
32,000	2371	2371 2780 2585	2585	2389	2212	2389 2212 2216 2404 2877 3774	2404	2877	3774	1609
33,000	2469	2907	2749	2590	2398	2469 2907 2749 2590 2398 2404 2619 3224 4451 7300	2619	3224	4451	7300

TABLE 4-24

FUEL FLOW RAILS FOR THE GIVEN CONDITIONS IN LASZHK TEMPERATURE: 35 C BASIC FUEL FLOW PRESSURE: 10000 FT

GR055	W. Carlotte			FLIG	HT MOD	FLIGHT MODE (KTS)	1			
(182)	HIGE	HOGE	NOE	40	09	80	100	120	140	160
20,000	E + + 1	1635	1487	1339	1229	1201	1246	1361	1582	21:14
24.000	2 9671	900	1798	1651	1437	1382	1458	1657	1969	2529
28,000	2083	2422	2422 2200	1978	1978 1823	1814	1946	2243	2785	3896
32,000	2479	2922	2827	2731	2526	2528	2759	3512	0215	8380
33,000	2593	3062	3021	3062 3021 2980 2751 2752 3019 3982 6212	2751	2752	3019	3982	6212	9881

DELTA FUEL FLOW FOR DRAG DATA TABLES

TABLE 4-25

CORRECTION FUE! FLOW LBS/HR FOR EXTERNAL DRAG

PRESSURE: SEA LEVEL TEMPERATURE: -25 C

CHINDOK

			AIF	SPEE	AIR SPEED IN KTS	15		
The state of the s	_	0+	09	8.0	100	120	140	160
000	. 05	61.	62	147	295	510	837	1201
3 2 2	100	37	124	297	589	1016	1612	2402
1100	150	95	187	440	887	1524	91,5	3603
SAUANE PER	200	74	250	109	1179	2031	3221	4804

TABLE 4-26

CORRECTION FUEL FLOW LBS/HR FOR EXTERNAL DRAG

AIRCRAFT - CH-47A

CHINDOK

			AIF	SPEE	AIR SPEED IN KTS	TS		
	\$ (1.7)	06	09	- 80	001	120	140	160
0	05	-11-	88	137	270	472	8 h L	1109
2 2	100	34	115	274	644	647	2641	1222
	150	51	173	413	918	1413	2236	3332
SAUAKE PEET	200	89	162	155	1093	1881	1862	6444

TABLE 4-27

CORRECTION FUFI FLOW LBS/HR FOR EXTERNAL DRAG PRESSURE: SEA LEVEL TEMPERATURE: 15 C

AIRCRAFT - CH-47A

			11 V	S SPEE	AIR SPEED IN KTS	T.S		
		40	09	0.0	100	120	140	160
	5.0	16	54	128	549	440	700	1036
2 × 5	100	32	108	152	504	880	1390	2070
N 100	150	2 h	161	383	758	1314	2082	1016
SAUANE FEET	200	63	215	514	1013	1751	2775	4138

TABLE 4-28

CORRECTION FUFI FLOW LUS/HR FOR EXTERNAL DRAG PRESSURE: SEA LEVEL TEMPERATURE: 35 C

			A 1	R SPEF	AIR SPEFD IN KTS	15		
	1.000	40	09	08	100	120	140	160
0	5.0	15	5.3	119	232	410	653	970
9	100	30	101	238	469	819	1301	1937
2	150	45	151	357	708	1232	6461	2904
SQUARE FEET	200	65	201	479	444	8691 445	2597	3871

TABLE 4-29

CURRECTION FUFI FLOW LBS/HR FOR EXTERNAL DRAG PRESSURE: 230, FT TEMPERATURE: -25 C

CHINDOK

			AIR	SPEE	SPEED IN KTS	15		T. T.
	0000	40	09	80	100	120	140	160
	90	17	5.8	138	275	475	750	1117
DRAG	100	35	116	278	548	546	1498	2234
- :	150	55	175	419	826	9141	2246	3350
SQUARE FEEL	200	7.0	234	655	1095	1887	2.994	4467

TABLE 4-30

CORRECTION FUri FLOW LBS/HR FOR EXTERNAL DRAG PRESSURE: 20ch Ft TEMPERATURE: -5 C

AIRCRAFT - CH-47A

•			AIF	SPEE	AIR SPEED IN KTS	TS		
		46	99	80	100	120	140	160
	9.0	16	53	127	252	438	69	1030
	100	32	107	552	205	879	1387	2063
2	150	48	191	386	760	1313	2079	3097
SQUARE FEET	200	49	215	213	1017	1749	1772	4130

TABLE 4-31

CORRECTION FUL! FLOW LBS/HR FOR EXTERNAL DRAG PRESSURE: 2000 FT TEMPERATURE: 15 C

AIRCRAFT - CH-47A

			A 1	ATR SPEED IN KTS	2 2 2	75		
Add Not a second		40	90	80	100	120	140	160
2400	05	15	5.0	811	233	404	650	196
2 2	100	30	100	237	479	819	1621	1923
1 1 10 100	150	5 b	661	357	705	1222	1935	2884
DWUARE PEEL	200	59	200	479	770	1638	2500	3045

TABLE 4-32

CORRECTION FUFL FLOW LBS/HR FOR EXTERNAL DRAG PRESSURE: 200, FT TEMPERATURE: 35 C

			IV	AIR SPEED IN KTS	INK	TS		
	02	40	9	80	100	120	140	091
	05	61	<i>4</i> h	111	216	382	809	106
ORAG	100	28	63	122	438	763	1209	1800
2	150	16	140	333	659	1146	1811	5698
SQUARE FEET	200	55	186	944	879	1523	2414	3598

TABLE 4-33

CORRECTION FUF, FLOW LBS/HR FUR EXTERNAL DRAG PRFSSURE: 4000 FT TEMPERATURE: -25 C

AIRCRAFT - CH-47A

CHINDOK

			A I	AIR SPEED IN KTS	NIG	15		
A A NEW A CO		40	09	08	100	120	011	160
	05	16	54	129	256	442	969	1037
9 2 2 ·	100	33	109	260	510	877	1340	2074
	051	64	164	391	767	1315	2085	3111
SWUANE FEET	200	59	219	520	1017	1752	2779	4148

TABLE 4-34

CORRECTION FUEL FLOW LBS/HR FOR EXTERMAL DHAG PRESSURE: 400, FT TEMPERATURE: -5 C

AIRCRAFT - CH-47A

			AIF	SPEE	AIR SPEED IN KTS	TS		
	0.00	40	99	9.0	001	120	1 40	160
	8.0	15	Şċ	118	236	407	444	958
מאאס	100	30	100	238	. 471	8 15	1288	1917
2	150	45	150	360	708	1219	1831	2877
SQUARE PEEL	200	.09	201	481	945	1624	1624 2574	3836

TABLE 4-35

CORRECTION FUF, FLOW LBS/HR FOR EXTERNAL DRAG

PRESSURE: 4000 FT TEMPERATURE: 15 C

AIRCRAFT - CH-47A

And the state of particular and the state of			AIF	AIR SPEED IN KTS	NIC	TS		
	Property contracts	40	09	80	100	120	140	160
	. DS	14	46	601	218	380	603	891
DRAG	100	28	93	221	438	192	1198	1783
2	051	42	139	333	656	1135	1797	2676
SQUARE FEET	200	95	186	944	878	1512	2395	3569

TABLE 4-36

CORRECTION FUFI FLOW LBS/HR FOR EXTERNAL DRAG PRESSURE: 4000 FT TEMPERATURE: 35 C

			AIF	AIR SPEED IN KTS	NIO	15		1
The second secon		40	90	80	100	120	0 1 1	160
	20	13	43	102	202	356	585	833
DRAG	100	92	86	206	404	710	710 1122	1669
2	150	39	130	311	613	1063	1682	2504
SOUARE FEET	200	25	173	416	818	1415 2241	2241	.3339

TABLE 4-37

CORRECTION FULL FLOW LBS/HR FOR EXTERNAL DRAG PRESSURE: 66nn FT TEMPERATURE: -25 C

AIRCRAFT - CH-47A

			AI	R SPEF	AIR SPEFD IN KTS	, TS		
		40	99	១ឧ	160	120	140	160
	0.5	15	15	121	237	014	644	895
URAG	100	3.0	102	2+2	473	B14	1288	1924
2	150	46	153	363	711	1220	1933	2886
SQUARE FEEL	200	19	205	484	643	1626	2577	3848

TABLE 4-38

CORRECTION FUFL FLOW LBS/HR FOR EXTERNAL DRAG

TEMPERATURE: -5 C PRESSURE: 6000 FT

AIRCRAFT - CH-47A CHINOOK

			AIR	R SPEE	SPEED IN KIS	15		
		40	09	80	100	120	140	160
	05	1.4	47	111	220	378	865	168
2 4 .	100	28	ħ 6	223	437	754	1195	1781
_	150	42	141	336	658	1130	1421	2671
SWUANE PEE	200	95	188	447	876	1506	2388	3562

TABLE 4-39

CORRECTION FULL FLOW LBS/HR FUR EXTERNAL DRAG

PRESSURE: 6000 FT TENPERATURE: 15 C

AIRCRAFT - CH-47A

			AIR	SPEE	SPEED IN KTS	15		
		940	9	80	100	120	140	160
	5.0	13	43	102	203	352	558	827
2 2 2	100	26	87	206	407	706	1112	1655
,	150	39	130	311	610	1053	1667	5484
SAUANE PEE	200	25	175	914	816	1403	2222	3312

TABLE 4-40

CORRECTION FUFL FLOW LBS/HR FOR CXTERNAL DRAG PRESSURE: GUDA FT TEMPERATURE: 35 C

AIRCRAFT - CH-47A

			AIR	R SPEE	SPEED IN KTS	. 15		
		40	09	08	100	120	140	091
3,40	20	12	04	56	189	330	h25	772
2 .	109	24	18	761	380	999	1001	1547
2	150	37	122	062	570	985	1559	2321
SAUANE PERI	200	64	163	388	762	1313	2078	3096

TABLE 4-41

CORRECTION FULL FLOW LBS/HR FUR EXTERNAL DRAG

PRESSURE: 800M FT TEMPERATURE: -25 C

AIRCRAFT - CH-47A

			AI	AIR SPEED	D IN KTS	15		
		40	29	80	100	120	140	160
0.00	2.0	† 1	47	113	219	380	296	892
2 2	100	28	9.5	225	439	754	1193	1783
1939 301103	150	42	143	337	859	1130	1790	2675
	200	99	190	644	874	1507	2387	3566

TABLE 4-42

CORRECTION FUE! FLOW LBS/HR FOR EXTERNAL DEAG

PRESSURE: 80gn FT TEMPERATURE: -5 C

AIRCRAFT - CH-47A

			AIA	AIR SPEED IN KTS	J IN K	TS		
		40	09	80	100	120	140	160
0.00	20	. 13	44	164	504	351	455	828
2 .	100	26	8.8	208	465	869	1167	1650
	150	39	132	312	611	1046	1659	2475
SAUARE PEE	200	52	176	415	810	810 1395	2122	3300

TABLE 4-43

CORRECTION FUEL FLOW LUSTHE FOR EXTERNAL DRAG PRESSURE: BURN FT TEMPERATUME: 15 C

			AIR	SPEE	SPEED IN KTS	15		
() () () () () () () () () ()		40	09	80	100	120	140	160
2440	0.5	12	16	96	189	325	216	769
2 2	100	24	81	193	378	653	1031	1536
Tana Baring	150	36	122	290	267	975	1545	2304
	200	44	163	387	757	1299	2060	3072

TABLE 4-44

CORRECTION FUR! FLOW LBS/HR FOR EXTERNAL DRAG PRESSURE: BUGG FT TEMPERATURE: 35 C

CHINDOK

			AIA	AIR SPEED IN KIS	NIC	TS		
		96	90	80	100	120	146	160
	5.0	11	38	68	177	304	484	718
DRAG	100	23	94	180	353	612	964	1436
z	150	34	114	271	529	912	1445	2154
SQUARE FEET	200	. 45	153	362	708	1215 1926	1926	2872

TABLE 4-45

CORRECTION FULL FLOW LBS/HR FOR EXTERNAL DRAG

PRESSURE: 10000 FT TEMPERATURE: -25 C

AIRCRAFT - CH-47A

CHINOOK

			AIR	S SPEE	SPEED IN KTS	TS		
	1.800	46	69	80	100	120	140	301
	05	13	44	105	202	351	551	828
9 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	100	26	88	208	407	869	1104	1691
	150	39	132	311	607	1047	1657	2476
SWUANE FEET	200	52	176	914	809	1395	2210	3301

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TABLE 4-46

CORRECTION FUFL FLUW LBS/HR FOR EXTERMAL DRAG PRESSURE: 10000 FT TEMPERATURE: -5 C AIRCRAFT - CH-47A

			AIF	AIR SPEED	STA NI C	. 51		
	\$40	0.6	90	80	100	120	140	160
2400	20	1.2	41	46	189	326	511	764
	100	. 42	82	193	376	949	1022	1528
<u> </u>	. 051	36	122	289	565	696	1534	2292
SWOAKE PEE	200	4.6	191	384	749	1921	2046	3055

TABLE 4-47

CORRECTION FUFL FLOW LBS/HR FOR EXTERNAL DRAG PRESSURE: 10040 FT TEMPERATURE: 15 C

AIRCHAFT - CH-47A

CHINDOK

			AIR	SPEE	SPEED IN KIS	TS		
		40	69	80	100	120	140	091
100	05	11	38	06	175	302	476	012
DRAG	100	22	7.6	180	349	109_	952	171
Z	. 051	34	114	209	528	206	1428	2132
SQUARE FEET	200	45	152	358	669	102!	1904	2843

TABLE 4-48

CORRECTION FUFI FLOW LBS/HR FOR EXTERNAL DRAG PRESSURE: 10000 FT TEMPERATURE: 35 C

			IV	R SPEE	AIR SPEED IN KTS	:TS		
		40	09	80	100	120	140	160
	95	10	36	84	164	283	5 1 5	999
2 2	100	21	7.1	168	326	295	889	1329
•	150	31	107	252	492	843	1334	1994
SWUANE FEET	200	42	142	335	559	1124	1780	2658

GROUND IDLE FUEL FLOW DATA
TABLE

TABLE 4-49
GROUND IDLE FUEL FLOW
AIRCRAFT - CH-47A
CHINOOK

		PRESSI	PRESSURE ALTITURE (FT)	JAE (FT)			
		SEA LEVEL	2000	4000	6000	8000	1 0000
	-25 C	1220	1164	1072	1000	932	860
TEMPERATURE	-5 C	1200	1144	1052	. 086	912	840
DEGREES	1S C	1180	1,24	1032	096	892	820
CENTIGRADE	38 C	1160	1,04	1012	046	872	908

ENTRIES ARE AIRCRAFT FUEL FIOW RATES IN LBS/HR

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GROSS WEIGHT LIMITS DATA
TABLES

TABLE 4-50

GROSS WEIGHT LIMITS (DUE TO ENGINE)

TOR TAKEDFF CRITERIA HI 1008 OF MAXIMUM POWER (HOGE)

AIRCRAFT - CH-47A

CHINDOK

	22	PRES	PRESSURE ALTITUDE (FT)	TUDE (FT)			
		SEA LEVEL	2000	4000	0009	8000	10000
TEMPERATIOE	-25 C	49222	46511	43785	41036	38116	35354
OF COFFE	2 €	16130	43339	49417	37459	34732	32036
CENTIGOADE	15 C	42167	39346	36504	33859	31277	28866
) SE	37216	34754	32301	29903	27651	25545
			-	The state of the s			

ENTRIES ARE AIRCRAFT GROSS WEIGHTS IN LBS

STRUCTURAL GROSS WEIGHT LIMIT: 33000 LBS

TABLE 4-51

GROSS WEIGHT LIMITS
(OUE TO TRANSHISSION)
FOR TAKEOFF CRITERIA BI
1008 OF MAXIMUM POWER (HOGE)
AIRCRAFT - CH-47A
CHINOOK

		PRES	PRESSURE ALTITUDE (FT)	TUDE (FT)			
		SEA LEVEL	2000	COUP	0209	3008	1000g
	7 5Z-	40975	39787	38653	37570	36481	35354
NECEFES.	3 S-	39712	38599	37533	36460	35352	34207
CENTICOANG	J 51	38612	19546	36504	35413	34285	33138
- Carlos Anna	38 C	37642	36601	35527	34418	33286	32154

ENTRIES ARE AIRCRAFT GROSS WEIGHTS IN LBS

STRUCTURAL GRUSS BFIGHT LIMIT: 33030 LBS

TABLE 4-52

GROSS WEIGHT LIMITS

FOR TAKEOFF CHITERIA #2

958 OF KATED POWER. VERTICAL RATE UF CLIMB 450 FT/MIN. OGE AIRCRAFT - CH-47A

CHINDOK

		PRES	PRESSURE ALTITUDE (FT)	TUBE (FT)			
		SEA LEVEL	2000	4003	0009	8000	00001
	-25 C	46050	43555	41035	36486	35757	33171
LAFERATORE) 5-	43186	46534	37872	35098	32544	30011
TCN1160ANE	J 51	39437	36805	34148	31671	29250	27012
- EN LORNOL	⊃ s€	34767	32466	36174	27934	25832	73864

ENTRIES ARE AIRCRAFT GROSS WEIGHTS IN LBS

STRUCTURAL GRUSS REIGHT LIMIT: 33000 LBS

TABLE 4-53

GROSS WEIGHT LIMITS
LUVE TO TRANSMISSION)
FOR TAKEOFF CRITERIA &2

TRANSHISSION POWER LIMIT. VERTICAL RATE OF CLIMB 450 FI/MIN. nGE.

AIRCRAFT - CH-47A

CH.I NOOK

		PRESS	PRESSURE ALTITUDE (FT)	UDE (FT)			
		SEA LEVEL	2000	9004	0009	6008	10001
Ballevasanst	-25 C	39431	38364	37277	36249	35254	34238
DECOESE.) S-	38294	37226	36214	35235	34235	33196
CENTIGOANG	15 C	37239	36240	35273	34289	33267	32209
2	35 €	36316	35361	34393	33388	32347	31293

ENTRIES ARE AINCRAFT GROSS WEIGHTS IN LBS

STRUCTURAL GROSS REIGHT LIMIT: 33600 LBS

TABLE 4-54
GROSS WEIGHT LIMITS
(DUE TO FRGINE)
FOR TAKEOFF CRITERIA #3
100% OF MAXIMUM POWER (HIGE)

CHINOOK

		PRES	PRESSURE ALTITUDE (FT)	UDE (FT)			
		SEA LEVEL	2006	4000	9009	9008	10001
101100	-25 C	55313	52248	49164	46077	42796	39694
- PECEFFE	2 S-	51821	44675	45395	42068	39006	35981
CENTIS: POE	15 C	47391	44215	41022	38051	35152	32468
	⊃ 5 €	41977	39166	36418	33720	31187	28816

ENTRIES ARE AIRCRAFT GROSS WEIGHTS IN LBS

STRUCTURAL GROSS WEIGHT LIMIT: 33340 185

TABLE 4-55

GRUSS REIGHT LIMITS
(DUE TO TRANSMISSION)
FOR TAKEOFF CRITERIA #3
1008 OF MAXIMUM POWER (HIGE)
AIRCRAFT _ CH-47A
CHINOOK

		PRES	PRESSURE ALTITUDE (FT)	UDE (FT)	1000		0.00
		SEA LEVEL	2000	#00#	0009	6008	10000
	-25 C	46344	45055	43704	42327	46997	39694
ILMFERATURE OF COLL	J 5-	14671	43637	42280	40972	39687	38323
ULGREES.	15 C	43654	42315	41022	39757	38415	37159
CENTICKADE	3 SE	41424	41137	39896	38573	37303	36317

ENTRIES ARE AIRCRAFT GROSS WEIGHTS IN LBS

STRUCTURAL GRUSS REIGHT LIMIT: 33000 LBS

VELOCITY LIMITS DATA
TABLES

TABLE 4-56

VELOCITY LIMITS TABLE (INCLUDING FUEL FLOW RATES)

BRESSURE: SEA LEVEL TEMPERATURE: -25 C

CHINDOK

			-			1	20.00		70	TY NeveR
	ש ע.	RANGE	CONTINUOUS POWER	MAX INUQUS OWER	POWER (ENGINE)	MER INE)	LI	LIMITS	3	EXCEED
10	(KTS)	(LBS/HR)	VEL (KTS)	VEL FOFT		VEL F.F.		VEL F.F.	VEL (KTS)	VEL F.F.
GROSS WEIGHTS (LBS)			W W.				174			
20,900	181	2042	199	1296	412	8404	111	3109	130	+202
24,000	136	2236	185	3671	196	4048	167	3109	130	2126
28,000	136	2369	176	3671	981 .	4048	160	3109	130	2237
32,000	134	2463	991	3671	174	4048	153	3109	511	2105
33,000	134	8842	163	1296	171	4048	152	3109	111	2076

TABLE 4-57

(INCLUDING FUEL FLOW RATES) VELOCITY LIMITS TABLE

PRESSURE: SEA LEVEL TEMPERATURE: -5 C

	R	LONG	CONTINUOUS POWER	X UOUS ER	POWER (ENGINE)	IX VER NE)	TRANS	TRANSHISSION LIMITS	VELOC	VELOCITY NEVER Exceed
	VEL (KTS)	(LBS/HR)	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F.	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	(LBS/HR)
GROSS WEIGHTS (LBS)	NET T							1 2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	tin e	
20,000	142	2137	206	1636	223	3898	188	3137	130	1939
24.000	142	8422	194	3531	607	968€	178	3137	130	2039
28,000	0,1	2338	.180	3531	761	3898	891	3137	081	2147
32,000	135	2389	168	1838	111	3686	851	3137	511	2049
33,000	135	2422	165	3531	661	3898	951	3137	111	2033

TABLE 4-58

VELOCITY LIMITS TABLE (INCLUDING FUEL FLOW RATES)
DRESSURE: SEA LEVEL TEMPERATURF: 15 C

1	4	
3	C	
3	C	
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	-	
	3	
•	L	

	75	LONG RANGE	CONTI	MAX CONTINIOUS POWER	HAY POWER (ENGINE)	A X BER Ine)	TRANS	TRANSHISSION LIMITS	VELOC E	VELOCITY NEVER
	VEL (KTS)	(LBS/HR)	VEL (KTS)	(LBS/HR)	VEL	VEL F.F.		VEL F.F.	VEL (KTS)	VEL F.F.
GROSS WEIGHTS (LBS)		1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1			A PER					200
20,000	147	2160	661	3192	220	3629	197	3163	130	1888
24,000	b h 1	5222	185	3192	203	3629	184	3163	130	1985
28,000	140	1822	171	3192	185	3629	170	3163	130	2002
32,000	136	2382	160	3192	171	3629	160	3163	115	2037
33,000	136	2439	159	3192	691	3629	158	3163	1111	2032

TABLE 4-59

VELOCITY LIMITS TABLE

JRESSURE: SEA LEVEL TEMPERATURE: 35 C (INCLUDING FUEL FLOW RATES)

CHINOOR

	L(R)	LONG	COMTINUOUS POWER	IX IUOUS VER	POWER	MAÁ OWER GINEI	TRAMS	TRAHSMISSION LIMITS	VELOC E	VELOCITY NEVER Exceed
	VEL (KTS)	F.F.	VEL (KTS)	(LBS/HR)	VEL (KTS)	F.F.		VEL F.F.	VEL (KTS)	(LBS/HR)
GROSS REIGHTS (LBS)		100000000000000000000000000000000000000			A 177	E TRANSPORTER		F1 5/2 1/2 1/3 1	2 E C	
20,000	150	2152	184	2814	207	3243	204	3191	122	1772.
24.000	145	2193	171	2819	189	3243	187	3191	122	1864
28,000	140	2256	159	2814	172	3243	171	3191	-122	6961
32,000	138	2457	151	2814	162	3243	191	3191	108	1982
33,000	138	2547	147	2814	159	3243	158	3191	104	2000

TABLE 4-60

DRESSURE: 2000 FT TEMPERATURE: -25 C (INCLUDING FUEL FLOW RATES) VELOCITY LIMITS TABLE

	R	LONG RANGE	HAX CONTINUOUS POWER	HAX INUQUS	POWER (ENGINE)	VER NE	TKANSI L1	TKANSMISSION LIMITS	7 8 8 8	VELOCITY NEVER EACEED
A 1 C C C C C C C C C C C C C C C C C C	(KTS)	(LBS/HR)		(LBS/HR)	VEL (KTS)	(LBS/HR)	(KTS)	(LBS/HR)	ISINI	(L85/HR)
GROSS WEIGHTS (LBS)	Maria 10 	1 2 4 4 5 5 1 5 1 5 1 5 1 5 1 5 1 5 1 5 1 5			114		1866 • H			
20,000	133	161	195	3534	207	3853	841	3060	130	5161
24,000	137	2150	184	3534	193	3853	691	3060	130	2022
28,000	135	2248	173	3534	182	3853	191	3061)	130	2137
32,000	132	2331	163	3534	170	3853	153	3060	911	8202
33.000	132	5962	191	3534	191	3853	152	3060	111	2002

TABLE 4-61

(INCLUDING FUEL FLOW RATES) VELOCITY LIMITS TABLE

DOO FT TEMPERATURE: -5 C. AIRCRAFT - CH-47A PRESSURE: 2000 FT

	-18	LONG	HAX CONTINUOUS POWER	VUOUS VER	POWER (ENGINE)	A X INE)	TRAUS	TRAUSHISSION LIMITS	VELOC	VELOCITY NEVER
	VEL (KTS)	(LBS/HR)	VEL (KTS)	(LBS/HR)	VEL	(LBS/HR)	VEL (KTS)	VEL F.F.	VEL (KTS)	(LBS/HR)
GROSS WEIGHTS (LBS)								25 X		
20,000	142	2030	202	3293	220	3681	193	9000	130	1835
24,000 .	161	2128	881	3293	203	1896	180	3086	130	1938
28,000	181	2190	174	3293	185	1898	167	3086	130	1502
32,000	134	2312	162	3293	171	1896	157	9800	115	0661
33,000	134	2372	160	3293	891	1896	156	3086	111	1984

TABLE 4-62

(INCLUDING FUEL FLOW RATES) VELOCITY LIMITS TABLE

PRESSURE: 2000 FT TEMPERATURE: 15 C

AIRCRAFT - CH-47A CHINDOK

	, % T	LONG	CONTINUOUS POWER	W X VUCUS	MAX POWER (ENGINE)	A X FER I NE)	TRANS	TRANSHISSION LIMITS	VELOC	VELOCITY NEVER
	VEL (KTS)	(LBS/HR)	VEL (KTS)	(LBS/HR)	VEL (KTS)	VEL F.F.	VEL	F.F.	5	VEL F.F.
GROSS REIGHTS ILBS)						Or Like		Tu de la companya de	100	
20:000	147	2035	193	2954	515	3396	201	3111	122	1661
24,000	142	8802	178	2954	195	3396	184	3111	122	1787
28,000	137	8412	164	2954	177	3396	169	3111	122	1899
32,000	136	2962	155	2954	166	3396	159	3111	107	1915
33,000	135	2452	152	2954	163	3396	156	3111	103	1934

TABLE 4-63 VELOCITY LIMITS TABLE

PRESSURE: 2000 FT TEMPERATURE: 35 C

(INCLUDING FUEL FLOW RATES)

AIRCRAFT - CH-47A

Second Second	-		1			,			100	TY NEVEB
	78.	RANGE	COUTINDOUS POWER	UOUS ER	POWER (ENGINE)	MAA POWER NGINE)	I KANSI LII	KARSHISSION LIMITS	VELVE	VELVCIII TEVER
	VEL (KTS)	F.F.	VEL (KTS)	F.F.	VEL (KTS)	(LBS/HR)	VEL (KŢS)	F.F. (185/HR)	VEL (KTS)	VEL F.F.
GROSS NEIGHTS (LBS)		H 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1		1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	ALTER	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	D. L., 1 V4 (2) V4 (2)	10 2 N 10 10 10 10 10 10 10 10 10 10 10 10 10	PALS.	17.825.8844 E 48.8
20,000	146	8002	179	2603	102	3037	206	3134	114	1091
24,000	142	2058	164	2603	181	3037	185	3134	114	1691
200184	138	2912	154	2603	167	3037	170	3134	114	1823
32.000	136	2493	141	2603	154	3037	156	3134	100	1927
000'66	134	2610	134	2603	148	3037	151	46.16	95	1983

TABLE 4-64

UELOCITY LIMITS TABLE (INCLUDING FUEL FLOW RATES)

PRESSURE: 4000 FT TEMPERATURE: -25 C

	78	LONG	HAX CONTINUOUS FOWER	HAX INUOUS OWER	POWER	KAA Ower Gine)	THANS	TRANSMISSION LIMITS	VELOC	VELOCITY NEVER
	VEL (KTS)	(LBS/HR)	VEL (KTS)	(LBS/HR)	VEL (KTS)	VEL F.F.	VEL	VEL F.F.	VEL	(LBS/HR)
GR055 FEIGHTS (LBS)		AT RESTAND			70 tas 20 tas 30 tas	8 4 3 5 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	N. N. S.		70 L	
20,000	135	1897	195	3380	205	3851	181	3013	130	9191
24.000	136	1402	183	3380	192.	3651	171	3013	130	1926
28,000	134	2137	170	3380	177	1596	191	3013	130	2048
32,000	131	2522	160	3380.	991	3651	153	3013	115	1973
33,000	131	5303	158	3380	163	3651	151	3013		1962

TARLE 4-65

VELOCITY LIMITS TABLE (INCLUDING FUEL FLOW RATES)

«KESSURE: 4000 FT TEMPERATURE: -5 C

AIRCHAFT - CH-47A

	'B'	Long Range	HAX CONTINUOUS POWER	iuous ER	POWER (ENGINE)	A.A. E.R. I.NE.)	TRANS	TRANSHISSION LIMITS	VELOC	VELOCITY WEVER
X (4)	VEL	(LBS/HR)	VEL	LRS/HR3	VEL	(LBS/HR)		VEL F.F.	VEL (KTS)	(HH/SBT)
GROSS LEIGHTS (LBS)	100.00	TB2VSd1		134753			· · · · · · · · · · · · · ·	18 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	100 L	10 10 10 10 10 10 10 10 10 10 10 10 10 1
20.000	142	1923	198	3076	216	3445	961	3036	122	1634
24,000	0,1	5002	182	3076	961	3445	081	3036	122	1736
28.000	SEI	2074	168	3076	178	3445	991	3036	122	1856
32.000	133	2288	158	3076	166	3445	151	3036	107	1867
33,000	132	5382	155	3076	162	3445	151	3036	103	1886

TABLE 4-66

VELOCITY LIMITS TABLE

(INCLUDING FUEL FLOW RATES)

PRESSURE: 4000 FT TEMPERATURE: 15 C

AIRCRAFT - CH-47A CHINDOK

VFLOCITY HEVER EXCEED!	(LBS/HR)		1523	1623	1757	1870	1928
VFLOC1	VEL (KTS	10 M	114	114	1114	66	56
TRAHSMISSION LIMITS	(LBS/HR)	1 2 2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	3060	3060	3060	3060	3060
TRAHSH LIM	VEL (KTS)		203	183	168	154	1 40
I K I E R NE J	(LBS/HR)	1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	3156	3156	3156	3156	31.56
POWER	VEL	1 H 1 H 1 H 1 H 1 H 1 H 1 H 1 H 1 H 1 H	208	186	171	156	181
x uous ER	(LBS/HR)	S S S S S S S S S S S S S S S S S S S	2745	2745	2745	2745	2745
CONTINUOUS POWER	VEL (KTS)		188	171	159	146	140
LONG RANGE	(LBS/HR)		1913	1966	2077	2403	2520
R R	VEL (KTS)	100 mg	145	140	136	133	131
	76	GROSS WEIGHTS (LBS)	20,000	24,000	28,000	32,000	33,000

TABLE 4-67

VELOCITY LIMITS, TABLE (INCLUDING FUEL FLOW RATES)
PHESSURE: 4000 FT TEMPERATURE: 35 C

	78	LONG	CONTINUOUS POWER	AX Nuous Wer	FNO	POWER (ENGINE)	TRANS	TRANSHISSION LIMITS	VELOC E	VELOCITY NEVER
0.73	VEL	(LBS/HR)	VEL (KTS)	(LBS/HR)	VEL	VEL F.F. (KTS)		VEL F.F.	VEL (KTS)	VEL F.F.
GROSS NE 16HTS (LBS)	10 L	1.023.43	1 1 3 VET							10 S P N H H
20,000	146	1881	173	2415	194	2830	207	3083	104	1437
14,000	141	1943	159	2415	174	2830	183	3083	104	1548
8.000	. 138	2155	149	2415	162	2830	169	3083	104	1699
32,000	131	2566	. 124	2415	141	2830	147	3083	85	1899
33,000	129	9192	117	5162	134	2830	142	3083	29	1987

TABLE 4-68

VELOCITY LIMITS TABLE (INCLUDING FUEL FLOW RATES)

PRESSURE: 6000 FT TEMPERATURE: -25 C

AIRCRAFT - CH-47A

CHINGOR

	J.K.	LONG	CONTINUOUS POWER	A X NUOUS VER	HAX POWER (ENGINE)	AX Wer Ine)	TRANS	TRANSMISSION LIMITS	VELOC	VELOCITY NEVER
	(KTS)	(LBS/HR)	VEL (KTS)	(LBS/HR)		(LBS/HR)	(KTS)	F.F.	VEL (KTS)	(LBS/HR)
GROSS REIGHTS (LBS)										
20,000	136	1825	161	3181	201	3443	163	2968	122	1613
24,000	135	1935	178	3181	186	3443	171	2968	122	1722
28,000	132	2022	165	3181	171	3443	160	2968	122	1846
32,000	130	2230	156	3181	161	3443	152	2968	107	1846
33,000	125	2228	153	3181	158	3443	149	2968	103	1860

TABLE 4-69

(INCLUDING FUEL FLOW RATES) VELOCITY LIMITS TABLE PRESSURE: 4000 FT

TEMPERATURE: -5 C

日本のでは、これのではあることで、こ	Statement of the statem	Colonia programma de la California de la			1.5.					
	78	LONG	MAX CONTINUOUS POWER	A X Nuous HER	MAX POWER (ENGINE)	AX MER Ine)	TRANS	TRANSMISSION LIMITS	VELOC E	VELOCITY NEVER
	VEL (KTS)	(LBS/HR)	VEL (KTS)	(LBS/HR)		VEL F.F.	VEL (KŢS)	F.F.	VEL	(L85/HR)
GROSS KEIGHTS (LBS)		T B C Seek						C (18 20 C C C C C C C C C C C C C C C C C C	A 40 1	(F (R & 1) C C C C C C C C C
20,000	142	1818	193	2882	208	3198	198	1662	113	1465
24,000	137	5881	921	2882	187	3198	179	1662	113	1572
28,000	134	9102	162	2882	170	3198	164	1662	. 113	1713
32,000	131	0462	149	2882	156	3198	151	1662	66	1825
33,000	130	9442	144	2882	151	3198	146	1662	66	1880

TABLE 4-70

VELOCITY LIMITS TABLE (INCLUDING FUEL FLOW RATES)

FRESSURE: . 6000 FT TEMPERATURE: 15 C

AIRCRAFT - CH-47A

			-						The second secon	
	R	LONG	CONTINUOUS POWER	A X NUOUS VER	PONER (ENGINE)	A X FER I NE)	TKANS	TRANSMISSION LIMITS	S AFLOC	VELOCITY NEVER
	VEL (KTS)	(LBS/HR)	VEL (KTS)	(LBS/HR)	VEL (KTS)	F.F.	VEL (KTS)	(LBS/HR)	VEL (KTS)	(LBS/HR)
GROSS WEIGHTS (LBS)	V L								* 1	
20,000	143	1971	182	2559	200	.2934	204	3012	102	1357
24,000	138	1848	165	2559	178	2934	181	3012	102	1473
28,000	135	2072	154	2559	165	2934	167	3012	102	1631
32,000	130	9152	131	2559	441	2934	9 1 1	3012	83	1844
33.000	126	1594	125	2559	138	2934	0+1	3012	11	1939

TABLE 4-71

VELOCITY LIMITS TABLE (INCLUDING FUEL FLOW RATES)

PRESSURE: 6000 FT TEMPERATURE: 35 C

			-	The second secon						
	R	LONG	CONTINUOUS POWER	A X VUOUS NER	POWER (ENGINE)	A X Wer Ine)	TKANS	TKANSMISSION LIMITS	VELOC	VELOCITY NEVER
1 00 2 00 2 00 3 00 3 00 3 00 3 00 3 00 3	VEL (KTS)	(LBS/HR)	VEL (KTS)	KTS) (LRS/HR)	VEL	VEL F.F.	VEL	VEL F.F.	VEL (KTS)	VEL F.F.
GROSS PEIGHTS (LBS)	No.	1 + 2	912 3 914 37-4							
20,000	144	1769	168	2260	186	2626	205	3033	86	1294
24,000	138	1857	155	2260	168	2626	182	3033	98	1432
28,000	135	5612	138	2260	151	2626	162	3033	98	1623
32,000	126	2658	107	2260	125	2626	138	3033	67	2015
33,000	126	5843	93	2260	117	2626	132	3033	0	6

TABLE 4-72

VELOCITY LIMITS TABLE (INCLUDING FUEL FLOW RATES)

PRESSURE: 8000 FT TEMPERATURE: -25 C

AINCRAFT - CH-47A

CHINDOK

	אר	Lohe	MAX CONTINUOUS POWER	MAX INUOUS OWER	POWER	A > KER I NE)	TRANSI	TRANSMISSION LIMITS	VELOC E.	VELOCITY NEVER
	VEL (KTS)	(LBS/HR)	VEL (KTS)	(LBS/HR)	VEL (KTS)	(LBS/HR)	VEL (KTS)	F.F.	VEL (KTS)	(LBS/HR)
GROSS REIGHTS (LBS)		8 × 2 × 3						1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1		
20,000	137	1746	186	2965	194	3207	184	2927	113	1437
24,000	hel	1835	172	2962	179	3207	171	2927	113	1550
28,000	181	1960	160	5962	166	3207	159	2927	113	. 2691
32,000	124	220.8	148	5962	153	3207	147	2927	66	1798
33,000	123	.2335	143	2965	148	3207	142	2927	95	1855

100

TABLE 4-73

(INCLUDING FUEL FLOW RATES) VELOCITY LIMITS TABLE

CHINDOK

TEMPERATURE: -5 C

FRESSURE: 8000 FT

_						
VELOCITY NEVER	F.F. (LBS/HR)	1294	1418	1583	1798	1897
VELOC	VEL (KTS)	101	101	101	82	94
TRANSM15510N LIMITS	F.F. (LBS/HR)	2948	2948	2948	2948	2948
TRANSH	VEL (KŢS)	661	178	163	143	138
ER NE)	(LBS/HR)	2973	2973	2973	2973	2973
POWER	VEL (xTS)	200	179	163	144	138
IA UOUS ER	(LBS/HR)	2690	2690	2690	2690	0692
MAA CONTINUOUS POWER	VEL (K15)	187	169	157	136	130
h6 INGE	F•F• (LB5/HR)	1719	1871	6661	1242	2550
3.5	VEL (KTS)	141	135	132	126	125

20,000

28,000 32,000 33,000

GROSS WEIGHTS (LBS)

TABLE 4-74

(INCLUDING FUEL FLOW RATES)

PRESSURE: 8000 FT TEMPERATURE: 15 C

CHINDOK

The second second	-			popular in	-	in month	
VILLOCITY NEVER	(LBS/HR)	4 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	1225	8961	1951	1985	00
VF.LOC	VEL (KTS)	6.5.1	84	84	8.4	59	0
TRAKSMISSION LIMITS	F.F.	E. V. J.	2968	2968	2968	2968	8962
TRAKSP	VEL (KTS)		202	180	160	136	130
MAA OWER GINE)	VEL F.F.		2715	2715	2715	2715	27.15
PONER (ENGINE)	VEL (KTS)		061	171	153	129	121
.x IUOUS ER	(LBS/HR)		9862	2386	2386	2386	-2386
CONTINUOUS PORER	VEL (KTS)	18.55 10.00	175	091	144	115	104
LONG RANGE	(LBS/HR)		6291	1781	2120	2619	2794
RA	VEL (KTS)	100	141	136	132	125	124
	2 (0.00)	GROSS WEIGHTS (LBS)	20,000	24,000	28,000	32,000	33,000

TABLE 4-75

(INCLUDING FUEL FLOW RATES) VELOCITY LIMITS TABLE

DOG FT TEMPERATURE: 35 C AIRCRAFT - CH-47A PRESSURE: 8000 FT

CHINGOK

	אר	Lok6 Range	CONTI	MAX CONTINUOUS POWER	PONER (ENGINE)	A X NER I NE)	TRANS	TRANSMISSION LIMITS	VELOC	VELOCITY NEVER EXCEED
	VEL (KTS)	(LBS/HR)	VEL (KTS)	(L85/HR)	VEL (KTS)	VEL F.F.	31	VEL F.F.	VEL	(LBS/HR)
GROSS WEIGHTS (LBS)							3.2			
20,000	141	1655	162	2012	177	2434	201	2987	69	1421
24,000	138	1846	150	2102	162	2434	182	2987	69	1411
28,000	130	5922	122	2012	137	2434	153	2987	69	1667
32,000	120	0582	0	2102	102	2434	125	2987	0	0
33,000	114	6962	0	2012	98	2434	115	2987	0	0

TABLE 4-76

VELOCITY LIMITS TABLE

(INCLUDING FUEL FLOW RATES)

ORESSURE: 10000 FT TEMPERATURE: -25 C

AIRCRAFT - CH-47A

CHINOOK

	يَ وَ	LONG	HAX CONTINUOUS PORER	A X VUQUS VER	HAY POWER	4 X 4 E R 1 NE J	TRANS	THANSHISSION LIMITS	VELOC	VELOCITY NEVER
	VEL (KTS)	(LBS/HR)	VEL (KTS)	VEL F.F.	VEL (KTS)	VEL F.F. KTS) (LBS/HR)		VEL F.F.	VEL (KTS)	VEL F.F.
GKOSS WEIGHTS (LBS)	18.2.2	17 G 20 G 40			34	2 H X 2 H 2		KAT T	44.0	L SEVHBY
20.000	981	2491	182	12757	061	2964	187	2888	101	1258
24,000	132	1734	166	1275	172	2984	170	2888	101	1388
28,000	130	0961	155	2757	160	2984	158	2888	101	1558
32,000	122	2337	135	1512	141	2984	139	2888	82	1766
33,000	121	2472	139	2757.	136	2984	133	2888	16	1862

TABLE 4-77

VELOCITY LIMITS TABLE
(INCLUDING FUEL FLOW RATES)
PRESSURE: 1000G FT TEMPERATURE: -5 C

AIRCRAFT - CH-47A

-
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(
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:
1

VER	HR.			5			
VELOCITY NEVER EXCEED	(LBS/HR)		1167	1315	1521		
VELOC.	VEL (KTS)	04	83	83	83	Ö	0
TKAKSNISS104 LIMITS	F.F.		2907	2907	2907	2907	2907
TKAKSM LIM	VEL (KŢS)		197	175	156	134	127
IX FER INE)	F.F.		2746	2746	2746	2746	2746
POWER (ENGINE)	VEL (KTS)		190	170	153	129	122
INOUS FR	F.F.		1642	1642	1642	2491	1642
KAX CONTINUOUS POWER	VEL (KTS)		179	162	146	120	112
Lok6 Range	F.F.	C Branding	6191	1728	2083	2568	2731
78	VEL (KTS)		139	134	131	123	121
	1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	GROSS .	20,000	24,000	28,000	32,000	33.000

TABLE 4-78

VELOCIȚY LIMITS TABLE (INCLUDING FUEL FLOW RATES) PRESSURE: 10000 FT TEMPERATURE: 15 C

AIRCRAFT - CH-47A CHINGOK

	78.	LONG	MAK CONTINUOUS POWER	A K VUOUS VER	POWER (ENGINE)	A A GER (NE)	TRANS	TRANSMISSION LIMITS	VE LOC	VELOCITY NEVER
	VEL (KTS)	(LBS/HR)	VEL (KTS)	(KTS) (LBS/HR)		VEL F.F.		VEL FOF (KTS)	VEL (KTS)	VEL F.F.
GKOSS #EIGHTS (LBS)	(612)	F 52 MU	AET . 2.1	10 mm	KITS.		8 K 4 & 1	196460	A E P	(\$125 x 485) 8 x 8 x
20,000	139	9251	168	2209	181	2514	198	2925	67	1184
24,000	. 135	5/11	155	5209	591	7514	179	2925	67	1362
28,000	127	2612	128	2209	140	2514	151	2925	67	1636
32,000	911 .	2763	7.8	2209	107	2514	122	2925	0	0
33,000	113	6962	0	2209	92	2514	112	2925	0	0

TABLE 4-79

VELOCITY LIMITS TABLE
(INCLUDING FUEL FLOW RAFES)
ARESSURE: 10000 FT TEMPERATURE: 35 C

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	78	L, NGE RANGE	MAX CONTINUOUS POWER	MAX TINUOUS JOKER	PONER (ENGINE)	BAÄ OWER GINEJ	TRANS	FRANSHISSION LIMITS	3 2073A	VELOCITY NEVER Exceed
の対抗ない。	VEL (KTS)	F.F. (LBS/HR)	VEL (KTS)	F.F.	VEL (KTS)	VEL F.F.		VEL F.F.	VEL (KTS)	F.F.
GROSS WEIGHTS (LBS)	-14	1,000						17.00 to 14.50 to 15.00 to 15.	2 A	P. P. S. S. P. S.
20,000	139	1572	158	1952	170	2255	199	2943	0	CKEER 0
24.000	135	1884	139	1952	151	2255	173	2943	0	0
28,000	126	2375	101	1952	121	2255	144	2943	0	0
32,009	111	1806	0	1952	0	2255	108	2943	0	0
33,000	105	4618	0	1952	0	2255	95	2943	0	0

APPENDIX A FUNCTIONS FOR CALCULATING BASIC FUEL FLOW

there are four functions that can be used to consider the base week are

There are four functions that can be used to calculate the basic fuel flow for the CH-47A helicopter. In order to use the functions the following data is needed:

- 1. Flight Mode
- 2. Temperature
- 3. Pressure (altitude)
- 4. Gross weight

Which of the four functions will be used depends on the flight mode. The first function is for HIGE (Hover In Ground Effect).

FF (HIGE) = f (TEMP, ALT, GW)

The second function is for HOGE (Hover Out of Ground Effect).

FF (HOGE) = f (TEMP, ALT, GW)

The third function is for NOE (Nap of the Earth).

FF (NOE) = f (TEMP, ALT, GW)

The fourth function is for Forward Flight.

FF (Forward Flight) = f (AS, TEMP, ALT, GW)

The equation for FF (HIGE) is:

FF (HIGE) = A (ALT) + B (TEMP) + C (GW) + D (ALT)(TEMP) + E (ALT) (GW) + F (TEMP) (GW) + G (ALT) (TEMP) (GW) + K

Where ALT is the altitude, TEMP is the temperature and GW is the gross weight and the constants have the following values:

 $A = -7.15665985 \times 10^{-2}$ E = 2.56930846 × 10⁻⁶

B = -2.3518604 $F = 1.80017465 \times 10^{-4}$

 $C = 5.13386521 \times 10^{-2}$ $G = 1.39370938 \times 10^{-8}$

 $D = -2.36933309 \times 10^{-4}$ $K = 5.08615311 \times 10^{2}$

The equation for FF (HOGE) is exactly the same form as FF (HIGE). A new set of values for the constants is used. These values are:

 $A = -7.89321018 \times 10^{-2}$

 $E = 3.07750736 \times 10^{-6}$

B = -2.75316495

 $F = 2.12039355 \times 10^{-4}$

 $C = 6.41560983 \times 10^{-2}$

 $G = 1.84186992 \times 10^{-8}$

 $D = -3.26415004 \times 10^{-4}$

 $K = 4.01074921 \times 10^2$

The equation for FF (NOE) is once again the same as FF (HIGE). The new values for the constants are:

A = -1.01870282 X 10-1

 $E = 3.82094487 \times 10^{-6}$

B = -2.33942565

 $F = 1.6026065 \times 10^{-4}$

 $C = 4.94293235 \times 10^{-2}$

 $G = 4.75979691 \times 10^{-8}$

 $D = -9.4832739 \times 10^{-4}$

 $K = 6.21096802 \times 10^2$

For the Forward Flight modes the form of the equation is:

FF = A(AS) + B(AS²) + C(AS³) + D(TEMP) + E(GW) + F(ALT) + G(AS³)(TEMP)

+ $H(AS^2)(TEMP)$ + I(AS)(TEMP) + $J(AS^3)(GW)$ + $K(AS^2)(GW)$

+ L(AS)(GW) + M(AS 3)(ALT) + N(AS 2)(ALT) + O(AS)(ALT) + P(TEMP)(GW)

+ Q(TEMP)(ALT) + R(GW)(ALT) + S(TEMP)(GW)(ALT) + T

Where AS is the air speed in kts and the values of the constants are:

A = -5.86449397

 $K = 5.84522547 \times 10^{-6}$

 $B = 6.03244249 \times 10^{-2}$

 $L = -8.03033821 \times 10^{-4}$

 $C = 1.18214637 \times 10^{-4}$

 $M = -1.0186316 \times 10^{-8}$

D = -3.21404946

 $N = -1.55880429 \times 10^{-6}$

 $E = 6.34362176 \times 10^{-2}$

N = -1.55880429 X 10

E - 0.34302170 x 10

 $0 = 2.36300752 \times 10^{-4}$

 $F = -8.69411761 \times 10^{-2}$

 $P = 1.57303326 \times 10^{-4}$

 $G = -6.00098531 \times 10^{-7}$

 $Q = -2.20658883 \times 10^{-4}$

 $H = -4.51068372 \times 10^{-4}$

R = 2.63398709 X 10⁻⁶

 $I = 4.31923866 \times 10^{-2}$

 $S = 1.1124619 \times 10^{-8}$

J = -1.36022993 X 10-8

 $T = 8.5389859 \times 10^2$

These functions allow anyone with a simple calculator to figure the fuel flow of the aircraft and bypass both looking up the values and interpolating for points in between the data points in the tables.

The above equations calculate the basic fuel flow for the CH-47A helicopter with the following accuracies:

For the commend Flight modes the form of the consistential

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FF (HIGE) - 99.33%

FF (HOGE) - 99.36%

FF (NOE) - 98.19%

FF (Forward Flight) - 98.09%

(D2) (S2A) A F CONTROL OF APPENDIX B

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FUNCTION FOR CALCULATING DELTA-FUEL FLOW FOR DRAG

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The function below will calculate the delta fuel flow for drag for the CH-47A helicopter. Recall from the discussion in chapter three that this value is added to the basic fuel flow value whenever drag is increasing the rate of fuel flow.*

In order to use the function the following data is needed:

- 1. Air Speed (AS)
- 2. Equivalent Square Footage of Drag (SQ)
- 3. Temperature (TEMP) in degrees centigrade
- 4. Altitude (ALT) in feet above sea level

That is:

The equation for FF (Drag) is:

$$+ G(AS^3)(TEMP) + H(AS^2)(TEMP) + I(AS)(TEMP) + J(AS^3)(SQ) + K(AS^2)(SQ)$$

$$+ L(AS)(SQ) + M(AS^3)(ALT) + N(AS^2)(ALT) + O(AS)(ALT) + P(TEMP)(SQ)$$

+
$$Q(TEMP)(ALT) + R(SQ)(ALT) + S(SQ)(ALT)(TEMP) + T$$

Where the constants have the following values:

$$A = -1.55468985$$
 $K = -2.21060582 \times 10^{-5}$ $B = 1.74179138 \times 10^{-2}$ $L = 2.58207321 \times 10^{-3}$ $C = 5.52420597 \times 10^{-5}$ $M = -1.4847501 \times 10^{-8}$ $D = 3.23438925$ $N = -1.75797179 \times 10^{-6}$ $E = 1.2785452$ $0 = 1.58675015 \times 10^{-4}$ $F = 2.6535566 \times 10^{-2}$ $P = -2.8082402 \times 10^{-2}$ $P = -2.04823664 \times 10^{-6}$ $P = -2.04823664 \times 10^{-6}$ $P = -2.47788365 \times 10^{-4}$ $P = -2.477883$

^{*}There is no delta fuel flow for drag for HIGE, HOGE or NOE flight.

This equation calculates the delta fuel flow for drag value with an accuracy of 99.67%. It should be noted that in some instances the computed value will be negative. If this occurs, zero (9) should be used as the value for delta fuel flow.

APPENDIX C FUNCTION FOR CALCULATING GROUND IDLE FUEL FLOW

The function below will calculate the ground idle fuel flow rate for the CH-47A helicopter. In order to use the function the following data is needed:

- 1. Temperature (TEMP) in degrees centigrade.
- 2. Altitude (ALT) in feet above sea level.

That is:

FF (Idle) - f (TEMP, ALT)

The equation, for FF (Idle) is:

FF (Idle) = A(TEMP) + B(ALT) + C(TEMP)(ALT) + D(TEMP 2) + E(ALT 2) + F

Where the constants have the following values:

 $A = -9.99999985 \times 10^{-1}$ D = 1.60979201 × 10⁻⁹

 $B = -3.73999695 \times 10^{-2}$ $E = 7.14257675 \times 10^{-8}$

 $C = -1.07357118 \times 10^{-11}$ F = 1.20071422 × 10³

This equation calculates the ground idle fuel flow rate with an accuracy of 99.75%.

APPENDIX D

FUNCTIONS FOR CALCULATING GROSS WEIGHT LIMITS FOR TAKEOFF

For take off oriteria #1 toy constants for translation limits and

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the same besit form with the values of the constants changing depending on which take off critaria is being used. In all cases the Structural

The functions given below will calculate the gross weight limits for take off for the CH-47A helicopter. Each of the functions is of the same basic form with the values of the constants changing depending on which take off criteria is being used. In all cases the Structural Gross Weight Limit of the CH-47A helicopter is 33,000 lbs.

In order to use the functions the following data is needed:

- 1. Temperature (TEMP) in degrees centigrade
- 2. Altitude (ALT) in feet above sea level

That is:

GW (Limit) = f (TEMP, ALT)

The basic equation for GW (Limit) is:

GW (Limit) = A(TEMP) + B(ALT) + C(TEMP)(ALT) + D

For take off criteria #1 the equation must be used twice, once using the engine limit constants and once using the transmission limit constants. For take off criteria #1 the constants for engine limits are:

 $A = -2.03450739 \times 10^2$ $C = 3.68664737 \times 10^{-3}$

B = -1.34642246

 $D = 4.46380747 \times 10^4$

For take off criteria #1 the constants for transmission limits are:

A = -5.39452381 X 10

 $C = 1.34714452 \times 10^{-4}$

B = -5.51487826 X 10⁻¹

 $0 = 3.95164639 \times 10^4$

For take off criteria #2 two checks must also be made. The constants for engine limits, take off criteria #2 are:

 $A = -1.91680241 \times 10^2$ $C = 3.32721538 \times 10^{-3}$

B = -1.25616817

D = 4.1769603 X 104

For take off criteria #2 the constants for transmission limits are:

A = -5.056429 X 10

C = 2.73357895 X 10-4

B = -5.08491784 X 10⁻¹

D = 3.80728213 X 104

Also for take off criteria #3 two checks must be made. The constants for engine limits, take off criteria #3 are:

A = -2.2619001 X 10² C = 4.13450238 X 10⁻³

B = -1.51476888

D = 5.01781396 x 104

For take off criteria #3 the constants for transmission limits are:

A = -6.65571413 X 10

 $C = 8.12428523 \times 10^{-4}$

 $B = -6.53947815 \times 10^{-1}$

 $D = 4.46635469 \times 10^4$

This equation with the various sets of constants gives results that are 99.79% accurate or better.

APPENDIX E SHORT DESCRIPTION OF CHINOOK (CH-47A) DATA SOURCE

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SUBJECT: Short Description of CH-47A Performance Data Provided to TRADOC Systems Analysis Activity (TRASANA)

MFR.

1. References:

- a. Operators Manual, Army Model CH-47A, TM55-1520-209-10.
- b. Category II Performance tests of the CH-47A Helicopter, Air Force FTC-TR-66-2.
- c. Determination of the Effects of Rotor Blade Compressibility on the Performance of the UH-IF; FTC-TR-65-17.
- d. Airworthiness and Qualification Test (Phase D), CH-47B Helicopter, USAASTA Project 66-23.
- 2. The performance data presented to TRASANA is the result of combining the helicopter power required, engine power available and engine fuel flow characteristics. The CH-47A power required was calculated from a non-dimensional representation of engine power required (coefficient of power) v.s. gross weight (coefficient of thrust) and true airspeed (advance ratio). The non-dimensional power required was obtained from reference 1b. All performance in ground effect represents a 10 foot wheel height. A temperature dependent correction, based on the method outlined in reference 1c, was made to the power required to account for compressibility which could not be accounted for in the non-dimensional representation.
- 3. The T55-L-7C engine power available to the CH-47A (which was used in combination with the power required to find helicopter take-off and speed limits) was used as a function of altitude and temperature, from reference ld.
- 4. The engine fuel flow at a particular altitude and temperature combination was derived from a representative referred fuel flow as a function of referred engine power. The referred fuel flow curve for the T55-L-7C engine was taken from reference ld. The calculated fuel flows reflect 5% conservation. A referred parameter is one which is divided by temperature and pressure ratios in order to represent all atmospheric conditions by one function,
- 5. The never exceed speeds (Vn.e.) were calculated from those shown graphically in reference la.
- 6. The Structural Gross Weight limit of the CH-47A is 33000 lbs.

JAMES A. O'MALLEY III Struc & Aeromech Br